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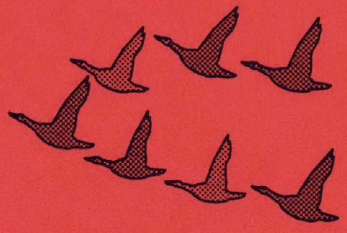
United States
Department of
Agriculture

Forest Service

Northeastern
Forest
Experiment
Station

Research Attainment Report

Fiscal Year 1992



Abstract

This report contains information on research attainment during fiscal year 1992 at the Northeastern Forest Experiment Station of the USDA Forest Service. Data presented include the funding and staffing for each problem, a narrative summary of the attainment in each problem, and a bibliography of all publications resulting from this research.

KEYWORDS: Research, attainment, research management

Northeastern Forest Experiment Station 1992. Research Attainment Report: Fiscal Year 1992. Radnor,PA U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 177p.

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Preface

This attainment report serves as one basis on which to evaluate USDA Forest Service research programs and work unit performance. It also provides information required by the Congress, the Department of Agriculture, and the Office of Management and Budget for their use in evaluating Forest Service research progress. This report for the Northeastern Forest Experiment Station will be aggregated with reports from other Forest Experiment stations to prepare a national report on research programs and accomplishments.

The basis for this report is the Research Work Unit Description (RWUD) for each work unit. The RWUD defines each unit's mission and problems to be studied to accomplish that mission. The approach to detailed investigation of each problem is described in a problem analysis. The problem analysis serves as a basis for preparing a series of study plans, each contributing to the problem solution, and ultimately, to accomplishment of the work unit mission.

Introduction

The Research Work Unit Attainment Reports in Part I each begin with a Research Work Unit Summary. This summary is in the form of a table, listing the problem number and title, the functional account funding the problem, the current level of funding, the current staffing (scientist years) and a tally of the number of publications produced, whether in the work unit, through extramural research, or through cooperative research.

The Research Work Unit Summary is followed by further information for each problem giving the attainments for a single problem. These reports give bibliographic information on each publication resulting from the research on a particular problem, plus a narrative summary of the attainment for that problem.

Part II is a bibliography of all the publications produced as a result of research conducted by the Northeastern Forest Experiment Station in Fiscal Year 1992, listed in alphabetical order by author under the proper functional account.

Research Attainment Report
Fiscal Year 1992

United States Department of Agriculture
Forest Service
Northeastern Forest Experiment Station

Part I: Research Work Unit Attainment Reports

Northeastern Forest Experiment Station
Forest Management Research
Research Work Unit 4101

Growth and Culture of Central Appalachian Hardwoods
Smith, H. Clay, Project Leader

FY 92 Research Attainments
Research Work Unit Summary

Problem number and title	Functional account	Current funding	Current staffing	Research Outputs		
				Research unit	Extra-mural	Cooper-ative
		thousand dollars	*scientist years*			
1. Lack of adequate economic information for comparing various silvicultural alternatives	FMR	107	1.0	2		1
2. Ecologically proven and environmentally acceptable alternatives to clearcutting	FMR	301	.7	1		
3. Guidelines to better address current silvicultual and forest management challenges	FMR	298	2.5	5		2

Problem 1 **Lack of adequate economic information for comparing various silvicultural alternatives**
FY 92 Research Attainments

Publications

Research Unit

Miller, Gary W. 1991. Economic residual stand structure goals for single-tree selection in central Appalachian hardwoods. In: Coleman, Sandra S.; Neary, Daniel G., comps. Proceedings of the 6th biennial southern silvicultural research conference; 1990 October 30-November 1; Memphis, TN. Gen. Tech. Rep. SE-70. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station Vol. 2: 821-831.

Miller, Gary Y. 1991. Practicing uneven-age management: Does it pay? Some economic considerations. In: Vodak, Mark C., ed. Proceedings, Uneven-aged management of hardwoods in the Northeast; 1991 April 9-10; Lambertville, NJ. New Brunswick, NJ: Rutgers University: 47-59.

Cooperative

Gansner, David A.; Arner, Stanford L.; Dale, Martin E.; Smith, H. Clay. 1991. Reports of demise greatly exaggerated:W.Virginia has major timber potential. The Northern Logger and Timber Processor. 40 (2): 18, 19, 34, 35.

Attainment

Uneven-age silvicultural practices were evaluated for economic purposes as related to forest stand management. Where a desirable shade-tolerant species can be reproduced at each periodic cut, the selection practice can earn competitive rates of return. Likewise, the availability of the timber resource in West Virginia was reported. Based on potential silvicultural opportunities to harvest the timber, the potential cut could approach 100 mm cords (including 25 billion board feet of sawtimber) which amounts to 60 times the current annual harvest. Research results will help forest managers evaluate financial aspects of silvicultural practices as related to managing Appalachian hardwood stands. This published information provides economic information for a variety of silvicultural alternatives and management opportunities. Results are used by forest managers and landowners associated with public, industrial, and private land ownerships. Research information is disseminated at training-information sessions, on-site visits, publications, and videos.

Problem 2 **Ecologically proven and environmentally acceptable alternatives to clearcutting**
FY 92 Research Attainments

Publications

Research Unit

Smith, H. Clay. 1991. Managing hardwoods, alternative to single-tree selection–"How to". In: Vodak, Mark C., ed. Proceedings, Uneven-aged management of hardwoods in the Northeast; 1991 April 9-10; Lambertville, NJ. New Brunswick, NJ: Rutgers University: 66-74.

Attainment

Alternatives to single-tree selection are suggested for managing hardwood stands. Suggestions are based on the assumption that alternative practices must leave a partial residual stand overstory at all times. Practices include modifications of diameter limits and two-age silviculture with the latter involving the crop-tree management concept. Information provides ecologically and socially acceptable silvicultural alternatives that will help satisfy a greater variety of forest resource objectives. Published results and demonstration areas are reviewed periodically by forest managers, landowners, and the public. Currently there is considerable interest from the U.S. Forest Service, State organizations, and WESTVACO in applying and demonstrating two-aged management alternatives to clearcutting using the crop-tree management concept of leaving trees based on landowner objectives. Additional research information is available at training sessions, newspaper articles, videos, and one-on-one contact with specific landowners at their sites.

Problem 3 **Guidelines to better address current silvicultual and forest management challenges**
FY 92 Research Attainments

Publications

Research Unit

Chenwang, Peng; Williams, Roger N.; Galford, Jimmy R. 1990. Descriptions and key for identification of larvae of Stelidota Erichson (Coleoptera:Nitidulidae) found in America North of Mexico. Journal of the Kansas Entomological Society. 63 (4): 626-633.

Galford, Jim; Williams, Roger. 1990. Laboratory culture of the Nitidulids Stelidota octomaculata and S. ferruginea on acorns. Frass Newsletter. 13 (1): 3 p.

Galford, Jimmy R.; Weiss-Cottrill, Deloris. 1991. Response of insects to damaged and undamaged germinating acorns. Res. Pap. NE-656. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 3 p.

Lamson, Neil I.; Smith, H. Clay. 1991. Stand development and yields of Appalachian hardwood stands managed with single-tree selection for at least 30 years. Res. Pap. NE-655. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 6 p.

Williams, Roger N.; Galford, Jimmy R.; Purrington, Foster F. 1991. Parasites of Stelidota (Coleoptera:Nitidulidae). Entomological News. 102 (2): 90-94.

Cooperative

Griffin, Gary J.; Smith, H. Clay; Dietz, Albert; Elkins, John R. 1991. Importance of hardwood competition to American chestnut survival, growth, and blight development in forest clearcuts. Canadian Journal of Botany. 69: 1804-1809.

Williams, R.N.; Fickle, D.S.; Galford, J.R. 1992. Biological Studies of Brachyserphus Abruptus [Hym:Proctotrupidae], A NITIDULD PARASITE. Entomophaga. 37 (1): 91-98.

Attainment

Appalachian hardwood stands in West Virginia were managed for 30 or more years using single-tree selection regeneration practices. Stand yield data suggest that current stand growth will provide economic harvest cuts for several future cutting cycles. Acorn insect pest information concerning survival, damage, identification, and disturbution are summarized. Likewise 10-year information on the effects of hardwood competition on survival, growth, and blight development for American chestnut indicates the development of some apparent superficial (non-killing) cankers in absence of hardwood competition. Information will help foresters formulate guidelines related to regeneration practices, insect pests, and hopefully American chestnut. Published information provides guidelines and pertinent information to clientele. Current information is disseminated through publications, conferences, training sessions, newspapers, and individual requests.

Northeastern Forest Experiment Station
Forest Management Research
Research Work Unit 4102

Ecology and Management of Beech-Birch-Maple Types in the Northeast
Garrett, Peter W., Project Leader

FY 92 Research Attainments
Research Work Unit Summary

Problem number and title	Functional account	Current funding	Current staffing	Research Outputs		
				Research unit	Extra-mural	Cooper-ative
		thousand dollars	*scientist years*			
1. A refined and expanded land classification system is needed	FMR	213	1.7	2		
2. Need to improve silvicultural prescriptions for northern hardwoods and mixed wood stands	FMR	216	1.7	4		
3. Better procedures are needed for improving the quality of northern hardwoods	FMR	0	.0			
4. Timber and wildlife habitat integration	FMR	261	1.0			1
M5. A lack of mass production techniques prevents large-scale planting of pitchlobolly pine hyb.	FMR	31	.5	1		

Problem 1 **A refined and expanded land classification system is needed**
FY 92 Research Attainments

Publications

Research Unit

Leak, William B. 1992. Vegetative change as an index of forest environmental impact. Journal of Forestry. 90 (9): 32-35.

Smith, Marie-Louise. 1992. Habitat type classification and analysis of upland hardwood forest communities on the Middlebury and Rochester Ranger Districts, Green Mountain National Forest, Vermont. Madison, WI: University of Wisconsin. 134. M.S. thesis.

(Marie-Louise Smith was a cooperative-Education student in Project NE-4102 while pursuing the M.S. degree at the University of Wisconsin. She is now a PFT ecologist on the staff of that Project)

Attainment

Preliminary habitat type classification was developed for upland northern hardwood forest communities in central Vermont. The results of this work provided evidence that multi-factor ecological approaches to land classification and inventory are valid; confirmation of the environmentally integrative nature and interpretability of floristic associations over the landscape in this region; and demonstrated that similar approaches could facilitate stratification of landscapes into ecologically meaningful units. During the next few years we will expand this research to cover other locations and sites in the northeastern region.

Problem 2 **Need to improve silvicultural prescriptions for northern hardwoods and mixed wood stands**
FY 92 Research Attainments

Publications

Research Unit

Cullen, J.B.; Leak, William B. 1988. New Hampshire's timber resource: past-present-future. Concord, NH: Department of Resources and Economic Development, Division of Forest and Lands.

(Leak probably made the major contribution to this report and person's seeking this information are more likely to look under his name.)

Graber, Raymond E.; Leak, William B. 1992. Seed fall in an old-growth northern hardwood forest. Res. Pap. NE-663. Radnor, PA: U.S. Department of Agriculture, Forest Service Northeastern Forest Experiment Station. 11 p.

Hornbeck, James W.; Leak, William B. 1992. Ecology and management of northern hardwood forests in New England. Gen. Tech. Rep. NE-159. Radnor, PA: U.S. Department of Agriculture, Forest Service Northeastern Forest Experiment Station. 44 p.

(William Leak is a member of the staff of Project NE-4102 and a major contributor to this important publication)

Leak, William; Cullen, J.B. 1989. New Hampshire's timber resource: past-present. Forests and Lands. Concord, NH: New Hampshire Division of Forests and Lands. (Year 7)1:1.

Attainment

Need to improve silvicultural prescriptions. To support ecosystem management efforts, research findings were published on some of the ecological aspects of northern hardwood forests. Eleven years of seed records in old-growth northern hardwoods documented seed-year occurrence, timing of seedfall, and viability of beech, yellow birch, and sugar maple. Losses from nonviability, birds, small mammals, and insects averaged about 2/3 of the total crop; and losses were proportionally greater in poor seed years. The number of seeds required to produce one seedling varied from 12-13 in beech and sugar maple to 62 in yellow birch. The findings indicate that seed supplies may be limiting in certain years due to heavy losses, and that special site preparation measures or careful timing of harvest cuts might be required to ensure successful establishment. Also, a summary was published of the ecological, silvicultural, and hydrological findings on the northern hardwood type over the past few decades from Hubbard Brook and Bartlett Experimental Forests. Guidelines are presented on harvesting methods that will protect timber, water, wildlife, and esthetic values.

Problem 3 **Better procedures are needed for improving the quality of northern hardwoods**
FY 92 Research Attainments

Publications

none

Attainment

This problem should be terminated. Both scientists assigned to the problem have left the Forest Service and no further work is anticipated. One paper on branching was prepared but was never published

Problem 4 — Timber and wildlife habitat integration
FY 92 Research Attainments

Publications

Cooperative

DeGraaf, Richard M.; Yamasaki, Mariko; Leak, William B.; Lanier, John W. 1992. New England Wildlife: Management of forested habitats. Gen. Tech. Rep. NE-144. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 271 p.

(Yamasaki and Leak are members of Project NE-4102 and made major contributions to this publication.)

Attainment

TM and WL Habitat Integration Statement of Progress "New England Wildlife: Management of Forested Habitats" GTR NE-144 was published and released to the public in May 1992. A preliminary study to evaluate a nondestructive monitoring technique for terrestrial salamanders in northern hardwoods was completed in cooperation with RWU-4251; results to be published in the fall 1992. Other work in progress includes: (1) evaluating the longevity and use of standing dead trees as cavity nesting sites under different stand structure and composition conditions; (2) determining the germination and survival of red oak acorns/seedlings under pine and oak stands; (3) describing the distribution of breeding brown-headed cowbirds in forest-dominated landscapes; (4) determining terrestrial salamanders and their habitat; (5) describing the silvicultural effects of mixed wood intermediate sands treatments on small mammals and their habitat. New work began in FY 92 includes: (1) describing the effects of group selection and patch cutting on breeding bird habitat in forest-dominated landscapes; and (2) describing the distribution and occurrence of vespertilionid bats in forest-dominated landscapes on the White Mountain National Forest.

Problem M5 **A lack of mass production techniques prevents large-scale planting of pitchlobolly pine hyb.**
FY 92 Research Attainments

Publications

Research Unit

Garrett, Peter W., ed. 1991. Proceedings of a symposium on white pine provenances and breeding; 1990 August 5-11; Montreal, PQ. Gen. Tech. Rep. NE-155. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 105 p.

Attainment

Data files covering up to 21 years of growth for 50+ plantings of hybrid pine have been prepared for analysis. This work will be completed early in FY93 and several manuscripts prepared. Beyond that, the State of New Jersey, with our assistance, will establish a new breeding orchard to supply seed and cuttings for research purposes to cooperators around the country and world. During the past year we shipped scions to France and several mid-western states where growth in test plantings created demand for commercial quantities of seed. Existing plantings will be maintained for future long-term studies.

Northeastern Forest Experiment Station
Forest Management Research
Research Work Unit 4103

The Role of Environmental Stress on Tree Growth and Development
Tyree, Melvin T., Project Leader

FY 92 Research Attainments
Research Work Unit Summary

Problem number and title	Functional account	Current funding	Current staffing	Research Outputs		
				Research unit	Extra-mural	Cooper-ative
		thousand dollars	*scientist years*			
1. Better define and measure state of tree health in order to identify significant stress events	FMR	410	.6			
2. Understanding water-stress physiology: hydraulic sufficiency of stem to conduct water to leaves	FMR	307	1.5	4		
3. Physiological changes associated with acidic leaching of soil and leaf nutrients	FMR	304	1.5	2		
4. Expanded knowledge of tree chemistry and physiology needed to understand resistance of tree	FMR	73	1.0	2		

Problem 1 **Better define and measure state of tree health in order to identify significant stress events**
FY 92 Research Attainments

Publications

none

Attainment

We are in the third full year of our five year program. Annually collected soil, leaf and stem samples have again confirmed that declining sites are nutrient poor in K and/or Mg and also have soils of low pH. Fertilizer was applied to some subplots. Fertilizer was formulated and applied at application rates to restore declining sites to the nutrient status of healthy sites. Lime was applied to some subplots in addition to macronutrients. The application of macronutrients has improved tree health as judged by NAMP criteria; the addition of lime caused no extra improvement. Photosynthetic studies have indicated no difference between healthy and declining sites based on net assimilation rates measured on a leaf area basis, or when reported on a dry weight basis. We have written cooperative agreements with University cooperators to evaluate: (1) the influence of N on photosynthetic capacity and leaf area index and (2) the effects of nutrient deficiency on root turn over and frost tolerance and (3) the influence of drought and insect damage on the health of maple trees to see if differences from year to year in condition of "healthy" and "declining" stands can be accounted for by these factors. The seasonal pattern of reserve carbohydrate in xylem wood of healthy branches and twigs was similar to those from other areas of the tree. The results provides baseline information of reserve carbohydrates in healthy sugar maple trees for future research, and also a less pervasive method of sampling in quantifying tree health.

Problem 2 — Understanding water-stress physiology: hydraulic sufficiency of stem to conduct water to leaves
FY 92 Research Attainments

Publications

Research Unit

S. Yang; Tyree, M.T. 1992. A theoretical model of hydraulic conductivity recovery from embolism with comparison to experimental data on Acer saccharum. Plant, Cell and Environment. 15: 633-643.

Tyree, Melvin T.; Alexander, John; Machado, Jose-Luis. 1992. Loss of hydraulic conductivity due to water stress in intact juveniles of Quercus rubra and Populus deltoides. Tree Physiology. 10: 411-415.

Tyree, Melvin T.; Ewers, Frank W. 1991. The hydraulic architecture of trees and other woody plants. New Phytologist. 119: 345-360.

Tyree, Melvin T.; Snyderman, David A.; Wilmot, Timothy R.; Machado, Jose-Luis. 1991. Water relations and hydraulic architecture of a tropical tree (Schefflera morototoni). Data, models, and a comparison with two temperate species (Acer saccharum and Thuia occidentalis). Plant Physiology. 96: 1105-1113.

Attainment

A totally new method has been developed to measure the vulnerability of stems to embolism by drought stress. Stems are continuously perfused with water at slightly above atmospheric pressure while a central portion of the stem is subjected to high external air pressure until air bubbles are blown into the xylem vessels causing a decline in conductance. Both the new and old methods produce comparable results. The new method is the strongest proof yet of the air seedling hypothesis of xylem cavitation and it is much faster than the old method. The new method has been used to measure the vulnerability to cavitation on 7 tropical species of Ficus and on several other tropical trees and lianas. We have found strong correlations between habitat (moisture) preferences of species and vulnerability to xylem dysfunction to cavitation in both tropical species and in riparian cottonwoods in western Canada. We have also started a study of how water relations and solar energy budgets of Ficus fruit affects the survival of pollinating wasps and thus the reproductive success of the Ficus and wasp species. We have demonstrated that if the fruits do not transpire that the temperature inside the fruit rises enough to cause the death of the pollinators. The lethal temperature for the wasps is only a few degrees celsius above normal ambient fruit temperature.

Problem 3 **Physiological changes associated with acidic leaching of soil and leaf nutrients**
FY 92 Research Attainments

Publications

Research Unit

Tyree, Melvin T.; Scherbatskoy, Timothy D.; Tabor, Christopher A. 1990. Leaf cuticles behave as asymmetric membranes. Plant Physiology. 92: 103-109.

(Omitted from FY91 report)

Tyree, Melvin T.; Wescott, Charles R.; Tabor, Christopher A. 1991. Diffusion and electric mobility of ions within isolated cuticles of citrus aurantium. Plant Physiology. 97: 273-279.

Attainment

We have studied the rate of leaching of KCl from isolated cuticles by measuring how the conductance of the cuticle changes with time after a change in concentration of KCl in the bathing solution of cuticles. These measurements also provide information on ionic diffusion coefficients. The rate of diffusion of ions in leaf cuticles is 6 to 8 orders of magniture below that in water. In collaboration with University cooperators, we have studied the rate of leaching of nutrients from whole maple branches subjected to artificial acidic rain mists. We are comparing the rate constants of leaching to the electric mobility of the same ions from leaf cuticles isolated from the same branches to see if most of the nutrients might be passing through leaf cuticles or originating from bark or dry deposited materials on leaf and stem surfaces.

Problem 4 **Expanded knowledge of tree chemistry and physiology needed to understand resistance of tree**
FY 92 Research Attainments

Publications

Research Unit

Wilkinson, Ronald C. 1992. Variation in needles characteristics and transpiration of red spruce and seedling progeny from high and low elevation stands in northern Vermont. In: DeHayes, Donald H.; Hawley, Gary J., eds. Proceedings of the 1st northern forest genetics association conference; 1991 July 23-25; Burlington, VT. Burlington, VT: Northern Forest Genetics Association: 78-98.

Wilkinson, Ronald C.; Schaberg, Paul G. 1992. Altitudinal variation in growth, budbreak and susceptibility to balsam twig aphid damage of balsam fir from 6 Vermont seed sources. In: DeHayes, Donald H.; Hawley, Gary J., eds. Proceedings of the 1st northern forest genetics association conference; 1991 July 23-25; Burlington, VT. Burlington, VT: Northern Forest Genetics Association: 171-180.

Attainment

In a range-wide provenance test of red spruce it was found that calcium concentration of current-year needles in fall and winter was significantly correlated with the history of resistance or susceptibility of individual trees to winter injury. An especially strong relationship between foliar calcium concentration in December and severity of winter injury in that same year is consistent with proposed hypotheses that (1) a lag of cold tolerance development of needles of red spruce would predispose the species to freezing injury in early winter and (2) that calcium deficiency, perhaps induced by acidic deposition, has an effect on development of cold tolerance through its influence on cell membrane permeability. Two studies were initiated in cooperation with the University of Vermont. The influence of pollution-induced calcium perturbations on cold tolerance and winter injury of red spruce is being evaluated. Treatment groups of seedlings with differing levels of foliar calcium are being established for later acid mist treatment and physiological analyses. In a second study, a controlled experiment with red spruce seedlings to assess possible changes in cold hardiness, net photosynthesis, transpiration and foliar water content associated with mid-winter thaws was conducted. In preparation for field assessments of winter photosynthesis and transpiration, two commercial portable photosyntheses instrument were evaluated for use under winter conditions. The LI-6200 (LI-Cor Inc., Lincoln, NE, U.S.A.) was found to accurately estimate photosynthesis and transpiration even at the cold temperatures tested.

Northeastern Forest Experiment Station
Forest Management Research
Research Work Unit 4104

Methods for Measurement, Analysis, and Modeling of Forest Growth and Structure
Solomon, Dale S., Project Leader

FY 92 Research Attainments
Research Work Unit Summary

Problem number and title	Functional account	Current funding	Current staffing	Research Outputs		
				Research unit	Extra-mural	Cooper-ative
		thousand dollars	*scientist years*			
1. Traditional methods are inadequate for modeling effects of environmental changes on forest trees	FMR	226	1.5	1		
2. Present growth predictions inadequate and lack mgmt. strategies, responsive to envir. changes	FMR	226	1.5	5		

Problem 1 **Traditional methods are inadequate for modeling effects of environmental changes on forest trees**
FY 92 Research Attainments

Publications

Research Unit

Valentine, Harry T.; Bealle, Catherine; Gregoire, Timothy G. 1992. Comparing vertical and horizontal modes of importance and control-variate sampling for bole volume. Forest Science. 3 (1): 160-172.

Attainment

A stand-level, carbon-balance growth model has been developed and computerized for loblolly pine. The model predicts yearly production of biomass and components of photosynthesis, maintenance and constructive respiration. Model solutions are presented in both tabular and graphic forms. The model is being calibrated to try to gauge the effects of climatic change on future loblolly growth and yield. Stratifield importance sampling and control-variate sampling were evaluated and compared to unstratified procedures for estimation of bole volume. The stratified procedures were judged appropriate where two instruments (one for below, the other for above tree crown line) are used to obtain diameter measurements at random heights on the bole of the tree.

Problem 2 **Present growth predictions inadequate and lack mgmt. strategies, responsive to envir. changes**
FY 92 Research Attainments

'ublications

tesearch Unit

Gove, J.H.; Solomon, D.S. 1992. Maximizing and maintaining structural diversity within forest stands using mathematical programming models. In: Wood, Geoff; Turner, Brian, eds. Integrating forest information over space and time; 1992 January 13-17; Canberra, Australia. Canberra, Australia: ANUTECH Pty Ltd: 445-453.

Gove, J.H.; Solomon, D.S.; Fairweather, S.E.; Patil, G.P. 1991. Maximizing the diameter class diversity of uneven-aged northern hardwood stands. In: Buford, Marilyn A., comp. Proceedings of the 1991 Symposium on Systems Analysis in Forest Resources; 1991 March 3-6; Charleston, SC. Gen. Tech. Rep. SE-74. Asheville, NC: Southeastern Forest Experiment Station: 39-45.

Gove, Jeffrey H.; Fairweather, Stephen E. 1992. Optimizing the management of uneven-aged forest stands: a stochastic approach. Forest Science. 38 (3): 623-640.

Holmes, Michael J.; Reed, David D. 1991. Competition indices for mixed species northern hardwoods. Forest Science. 37 (5): 1338-1349.

Solomon, Dales S. 1992. Modeling uneven-aged northern hardwoods. In: Vodak, Mark C., ed. Proceedings of the conference: Uneven-Aged Management of Hardwoods in the Northeast; 1991 April 9-10; Lambertville, NJ. New Brunswick, NJ: Rutgers Cooperative Extension, Rutgers University: 40-46.

ıttainment

Annual measurements from 1975 to 1985 on 278 Maine spruce-fir infested by the spruce budworm were analyzed to determine the impact of species composition, growth and mortality. Analyses were done by forest type, density, host-species composition, diameter, and percent fir or spruce composition classes. Balsam fir accounted for about one-quarter of the initial 1975 basal area per acre in both forest types. Mortality of fir was half of this initial basal area by 1985 in mixedwood stands. Balsam fir mortality increased with increasing basal-area density in both forest types, with higher losses in denser stands of the softwood type. Heaviest losses in mixedwood stands usually occurred about 4 years after those in softwood stands. Research in the project over the past year has concentrated on new and innovative ways to use ecological diversity measures in forest management. A mathematical programming model has been developed which finds the optimal diameter distribution in an uneven-aged northern hardwood stand, and ensures that the distribution is at least as diverse as some target distribution. The implications are that optimal cutting guides may be determined for individual stands such that the horizontal structural diversity in those stands will not be less than the target stand after cutting. The same principles (intrinsic diversity ordering) used to formulate the above research were used in a comparative study of plant species diversity on two watersheds on the Hubbard Brook Experimental Forest in New Hampshire. The plant communities were compared for diversity assessment over time and between treatments.

Northeastern Forest Experiment Station
Forest Management Research
Research Work Unit 4151

Culture of Northeastern Spruce-Fir Forests
Garrett, Peter W. Acting, Project Leader

FY 92 Research Attainments
Research Work Unit Summary

Problem number and title	Functional account	Current funding	Current staffing	Research Outputs: Research unit	Research Outputs: Extra-mural	Research Outputs: Cooperative
		thousand dollars	*scientist years*			
1. The need to refine silvicultural prescriptions	FMR	330	1.3	3		
2. Enemies of spruce budworm not evaluated in context of silvicultural prescriptions	FMR	0	.0			
3. Cannot accurately predict growth and yield responses	FMR	0	.0			
4. Soil fertility, site productivity and the nutrient requirements of major species	FMR	0	.0			

Problem 1 — The need to refine silvicultural prescriptions
FY 92 Research Attainments

Publications

Research Unit

Frank, Robert M. 1991. Fact sheets for first 28 years of results: 3-stage shelterwood system. Unpublished report. Available from: Northeastern Forest Experiment Station, 5 Godfrey Dr., Orono, ME 04473. 18 p.

Frank, Robert M. 1991. Fact sheets for first 40 years of results: Selection system, intensive management, 5-year operating interval, Unpublished report. Available from Northeastern Forest Experiment Station, 5 Godfrey Dr., Orono, ME 04473. 15 p.

Frank, Robert M. 1991. Fact sheets for the first 30 years of results: Selection system, extensive management, 20-year operating interval. Unpublished report. Available from Northeastern Forest Experiment Station, 5 Godfrey Dr., Orono, ME 04473. 18 p.

Attainment

Progress in this problem was associated with a long-term precommercial thinning and fertilization study and with compartment management studies. Field work consisting primarily of inventory took place on ten compartments. These inventories are conducted on a 5-year interval schedule. Most compartments have had at least 10 inventories and some as many as 13. Compartments are treated over an array of silvicultural treatments and the long-term growth and yield data are maintained on computer tape. Some compartments are in their 40th year since treatment began. A major effort was made to compute tree diversity data to date from seedling through saw-timber material in the 10 treatments and assign likely wildlife habitat effects on various bird, small mammal and large mammal populations. Data summaries for those compartments inventoried were up-dated and put in the form of "fact sheet" handouts to be used on tours of the compartments by visitors. In 1992, a record 500 people in 19 groups visited the studies on the Penobscot Experimental Forest, representing 5 colleges, 8 private companies, 3 Federal/Provincial/State agencies and 3 general interest groups. Extramural research involving Global Climate Change funded from this problem will be reported by the Global Climate Change Research Program.

Problem 2 **Enemies of spruce budworm not evaluated in context of silvicultural prescriptions**
FY 92 Research Attainments

Publications

none

Attainment

No funding of this problem at current time. No progress to report this period.

Problem 3 **Cannot accurately predict growth and yield responses**
FY 92 Research Attainments

Publications

none

Attainment

No funding of this problem at this time. No progress to report this period.

Problem 4 **Soil fertility, site productivity and the nutrient requirements of major species**
FY 92 Research Attainments

Publications

none

Attainment

No funding of this problem at this time. No progress to report this period.

Northeastern Forest Experiment Station
Forest Management Research
Research Work Unit 4152

Silvicultural Decision Systems for Eastern Hardwood Forests of the Mid-Atlantic Region
Stout, Susan L., Project Leader

FY 92 Research Attainments
Research Work Unit Summary

Problem number and title	Functional account	Current funding	Current staffing	Research Outputs		
				Research unit	Extra-mural	Cooper-ative
		thousand dollars	*scientist years*			
1. How to control species composition during regeneration for a variety of objectives	FMR	539	2.0	4		2
2. Regulate stand growth and development to maximize multiple-use benefits from existing stands	FMR	187	.5	3		
3. Effects of silvicultural practices on wildlife habitat, aesthetics, and on diversity	FMR	270	1.5	9		1
4. Consolidate the vast array of multiple resource knowledge into a computer-based decision tool	FMR	108	.5	3		

Problem 1 **How to control species composition during regeneration for a variety of objectives**
FY 92 Research Attainments

Publications

Research Unit

Horsley, Stephen B. 1992. Mechanisms of interference between hayscented fern and black cherry. In: Gjerstad, Dean H.; Glover, Glenn R., comps. Program and abstracts from the international conference on forest vegetation management: ecology, practice and policy; 1992 April 27-May 1; Auburn, AL. Auburn, AL: Auburn University: 80. Abstract.

Horsley, Stephen B.; McCormick, Larry H.; Groninger, John W. 1992. Effects of timing of Oust application on survival of hardwood seedlings. Northern Journal of Applied Forestry. 9 (1): 22-27.

Walters, Russell S. 1991. Progress report for study plan 157: tree shelters for protecting northern red oak seedlings. In: Windell, Keith. Tree shelters for seedling protection. 9124-2834-MTDC. Missoula, MT. U.S. Department of Agriculture, Forest Service, Technology and Development Program: 96-116.

Walters, Russell S. 1992. Protecting red oak seedlings with tree shelters. Journal of the Pennsylvania Academy of Science 65 (Suppl.): 203. Abstract.

Cooperative

Galford, Jimmy R.; Auchmoody, L.R.; Walters, Russell S.; Smith, H. Clay. 1992. Millipede damage to germinating acorns of northern red oak. Res. Pap. NE-667. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 4 p.

Halgerson, Ole T.; Newton, Michael; deCalesta, Dave; Schowalter, Tim; Hansen, Everett. 1992. Protecting young regeneration. In: Hobbs, Stephen D.; Tesch, Steven D.; Owston, Peyton W.; Stewart, Ronald E., comps., eds. Reforestation practices in southwestern Oregon and northern California. Corvallis, OR: Oregon State University: 384-420.

Attainment

In many Allegheny hardwood and oak stands, regeneration lacks desired species or is dominated by a single species rather than a variety of desirable ones. Sometimes, woody regeneration is inhibited by interfering plants, excessive deer browsing, depredation by insects or disease organisms, or limiting levels of environmental conditions. A paper describing the biological mechanisms of interference between hayscented fern and black cherry was presented at the international conference on forest vegetation management. A paper outlining the effects of timing of the application of the herbicide Oust on woody species survival was published in the Northern Journal of Applied Forestry. This paper shows that red maple is insensitive to this herbicide, while late growing season applications allow seedlings of black cherry, the oaks and white ash to survive. White ash was the most sensitive to Oust of the species tested. Another paper reporting progress on a study of the use of tree shelters to protect red oak seedlings was presented to the Pennsylvania Academy of sciences. This paper shows unacceptably low survival rates of planted seedlings underplanted in a shelterwood in grown tree shelters.

Problem 2 — Regulate stand growth and development to maximize multiple-use benefits from existing stands
FY 92 Research Attainments

Publications

Research Unit

Auchmoody, L.R.; Walters, R.S.; Lilja, P. 1992. Impact of liming on forest soil chemical properties. In: Agronomy Abstracts 84: 343.

Marquis, David A. 1992. Stand development patterns in Allegheny hardwood forests, and their influence on silviculture and management practices. In: Kelty, Mathew J.; Larson, Bruce C.; Oliver, Chadwick D., comps., eds. The ecology and silviculture of mixed-species forests. Forestry Sciences number 40. Boston, MA: Kluwer Academic Publishers: 165-181.

Marquis, David A.; Ernst, Richard L.; Stout, Susan L. 1992. Prescribing silvicultural treatments in hardwood stands of the Alleghenies (revised). Gen. Tech. Rep. NE-96. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 101 p.

Attainment

Allegheny hardwood stands, like many eastern hardwood stands, are composed of complex mixtures of species. These stands contain trees that span the range of shade tolerance and growth rate. The cutting regimes or disturbances that establish these stands have a great influence on their stand development patterns, which in turn, influence the choice of appropriate silvicultural and management practices. A summary paper describing these interacting influences was published as part of a book on the ecology and silviculture of mixed species forests. A major revision of the silvicultural guidelines for managing hardwood stands of the Allegheny region for the production of high-value sawtimber products was published this year. This revision incorporates guidelines for soil productivity protection and regeneration guidelines that include area fencing as a regeneration treatment. Results of a study of the effects of liming on forest stand development, seed production, and regeneration patterns were reported at the annual meeting of the Soil Science Society of America and published as an abstract. Liming increased soil pH, Ca and Mg and decreased Al and Mn concentrations. These effects increased over time and diminished with increasing soil depth.

Problem 3 **Effects of silvicultural practices on wildlife habitat, aesthetics, and on diversity**
FY 92 Research Attainments

Publications

Research Unit

DeCalesta, David. 1992. Wildlife on the Kane Experimental Forest. Supplement to The Kane [PA] Republican and The Ridgway Record. Timber Issue, March 20: 26.

DeCalesta, David S. 1992. Impact of deer density on species diversity of Allegheny hardwood stands. In: Bellinder, R.R., ed. Proceedings, 46th annual meeting of the Northeastern Weed Science Society; 1992 January 6-9; Boston, MA. Ithaca, NY: Northeastern Weed Science Society: 135. Abstract.

Horsley, Stephen B. 1992. Species diversity of Allegheny hardwood stands over time after a single application of glyphosate. In: Bellinder, R.R., ed. Proceedings, 46th annual meeting of the Northeastern Weed Science Society; 1992 January 6-9; Boston, MA. Ithaca, NY: Northeastern Weed Science Society; 137. Abstract.

Marquis, David A. 1992. The Allegheny hardwood forest: Its history and origin. Supplement to The Kane [PA] Republican and The Ridgeway [PA] Record. Timber Issue, March 20: 37.

Marquis, David A. 1992. Accomodating biological and social issues in hardwood management: the Northeast region. In: Proceedings: 20th annual hardwood symposium of the Hardwood Research Council; 1992 June 1-3; Cashiers, NC. Memphis, TN: Hardwood Research Council: 111-125.

Marquis, David A. 1992. Alternative silvicultural systems–east. In: Proceedings, national silviculture workshop: silvicultural challenges and opportunities in the 1990's; 1989 July 10-13; Petersburg, AK. Washington, DC: U.S. Department of Agriculture, Forest Service, Timber Management: 36-45.

Stout, Susan L. 1992. Herbicide effects in a study of management strategies in Allegheny hardwoods. In: Bellinder, R.R., ed. Proceedings, 46th annual meeting of the Northeastern Weed Science Society; 1992 January 6-9; Boston, MA. Ithaca, NY: Northeastern Weed Science Society: 136. Abstract.

Stout, Susan L. 1992. The Kane Experimental Forest. Supplement to The Kane [PA] Republican and The Ridgway [PA] Record. Timber Issue, March 20: 41.

Stout, Susan L.; Horsley, Stephen B.; deCalesta, David S. 1992. Assessing plant species diversity: an important challenge in forest vegetation management. In: Bellinder, R.R., ed. Proceedings, 46th annual meeting of the Northeastern Weed Science Society; 1992 January 6-9; Boston, MA. Ithaca, NY: Northeastern Weed Science Society: 134. Abstract.

Cooperative

Schreiber, B.; deCalesta, D.S. 1992. The relationship between cavity-nesting birds and snags on clearcuts in western Oregon. Forest Ecology and Management. 50 (3-4): 299-316.

Attainment

The Kane Experimental Forest serves as the base for an expanding body of research analyzing the effects of silvicultural practices on wildlife habitat, aesthetics, and diversity. A paper presented to the National Silviculture Workshop describes some of the alternative silvicultural systems being used in eastern forest types to achieve these objectives. A series of articles in the popular press outlined the research underway to document these effects. Scientists from RWU-NE-4152 delivered a mini-symposium, consisting of four papers, to the Northeastern Weed Science Society annual meeting, to outline the effects of deer density, herbicide, and mmanagement strategy on species diversity in Allegheny hardwoods. This mini-symposium also identified the potential relationship between species diversity research and biodiversity concerns.

Problem 4 **Consolidate the vast array of multiple resource knowledge into a computer-based decision tool**
FY 92 Research Attainments

Publications

Research Unit

Ernst, Richard L. 1992. SILVAH: A stand prescription tool. The Compiler. 10 (2): 43-45.

Marquis, David A. 1992. A multi-resource silvicultural decision model for forests of the northeastern United States. In: Buford, Marilyn A., comp. Proceedings, 1991 symposium on systems analysis in forest resources; 1991 March 3-6; Charleston, SC. Gen. Tech. Rep. SE-74. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station: 358-365.

Marquis, David A.; Ernst, Richard L. 1992. User's Guide to SILVAH. Gen. Tech. Rep. NE-162. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 124 p.

Attainment

The SILVAH computer software package and the Northeastern Decision Model are computerized decision support systems for land and resource managers. The "User's Guide to SILVAH" and associated article in The Compiler document the capabilities and concepts of SILVAH. With SILVAH, land and resource managers can analyze forest stand inventory data, and, after providing stand management objectives for timber production, derive a prescription that captures the expertise of the research staff of RWU-NE-4152. At a symposium on systems analysis in forest resources, a paper describing how these concepts will be applied to a much wider array of management objectives and several forest types in the Northeast Decision Model was presented.

Northeastern Forest Experiment Station
Forest Management Research
Research Work Unit 4153

Growth, Yield, and Value Development of Northeastern Forest Types
Scott, Charles T., Project Leader

FY 92 Research Attainments
Research Work Unit Summary

Problem number and title	Functional account	Current funding	Current staffing	Research Outputs: Research unit	Research Outputs: Extra-mural	Research Outputs: Cooperative
		thousand dollars	*scientist years*			
1. Develop techniques which show the consequences of applying alternative management options	FMR	666	3.0	2		1
2. Techniques for predicting wood quality and value development in woodlands are needed	FMR	35	.5	2		
3. How the non-industrial private forest owner can evaluate forest management alternatives	FMR	0	.0			

Problem 1 **Develop techniques which show the consequences of applying alternative management options**
FY 92 Research Attainments

Publications

Research Unit

Yaussy, Dan. 1992. Techno-forester. The Ohio Hetuch. 16 (3): 14-15.

(The official newsletter of the Ohio Society of American Foresters)

Yaussy, Daniel; Gale, Peg. 1992. The woodman's ideal growth projection system TWIGS. The Compiler. 10 (2): 28-42.

(The Compiler is published for FORS (Forest Resources Systems Institute). The article is part of the Proceedings of the FORS Eight Annual Conference, "Harnessing Computer Technology for Natural Resource Management")

Cooperative

Kohl, M.; Scott, C.T. 1992. Survey planning for national forest inventories. In: Wood, G.B., Turner, B.J., eds. Integrating forest information over space and time; 1992 January 13-17; Canberra, Australia. Canberra, Australia: ANUTECH Pty. Ltd.: 325-328.

(Proceedings of the International IUFRO Conference.)

Attainment

In the late 1950's and early 1960's a series of studies were installed in the upland oak type to determine if size of opening affected the growth rate and species composition of new stands. In 1991 we examined the current regeneration, about 30 years after cutting, in 1989 such openings that ranged in size from 0.05 acres up to 1.75 acres. Species composition varied somewhat from locations in West Virginia to those in Illinois and from Ohio to Kentucky. For example, we found more red maple and tulip poplar in West Virginia than in Illinois regardless of the opening size. Some of the difference in species composition and growth rate is related to site quality as well as the size of opening. We found most of the oak and hickory on the lower sites and more yellow poplar and red maple on the better sites. Growth rates of the current stands seem to increase with opening size at least for openings up to one-half acre in size. Reduction in height growth and dbh is evident for at least a distance of 40 feet or more from the edge of the openings, but the effect of this border zone seems to be related also to the size of opening. Much of this information will be important to forest managers that are seeking alternatives to complete clearcutting as a viable method for harvesting stands. The data should be useful in helping to choose the particular size of opening that will best meet their specific management objectives.

Problem 2 **Techniques for predicting wood quality and value development in woodlands are needed**
FY 92 Research Attainments

Publications

Research Unit

Yaussy, Daniel A. 1991. Tree, log, and lumber quality models for eastern hardwoods. In: Pacific rim forestry–bridging the world: Proceedings of the Society of American Foresters national convention; 1991 August 4-7; San Francisco, CA. SAF Publ. 91-05. Bethesda, MD: Society of American Foresters: 99-106.

Yaussy, Daniel A. 1992. Upland oak growth and yield simulator thinning routine influenced by grade. In: Payandeh, Bijan, ed., Forestry Futures: Proceedings of Midwestern Forest Mensurationists; 1991 August 20-23; Sault Ste. Marie, ON. Ottawa, ON: Forestry Canada, Ontario Region: 61-68.

Attainment

To quantify the value potential of a tree in a simulator, some form of quality must be assigned. Methods have been developed which allow the distribution of butt-log grades over diameter at breast height. This provides a snapshot of quality, but does not indicate the potential quality of the trees. Potential grade is a variable which accounts for the change in tree quality over time. A method was developed to estimate the probability that a tree in an even-aged upland oak stand would be in one of four potential grade classes. For this forest type, it was found that species, dbh, and stand age were the variables most correlated with potential grade. When expanding this research to different forest types with indeterminate age structures, it was apparent that another stand variable needed to be found. Using the same upland oak data set, correlations were calculated between potential grade and basal area, site index, tree dbh relative to quadratic mean dbh, and basal area in trees with larger dbh. Site index had the highest correlation with potential grade of the variables tested. Site index does not change due to management practices, another factor in favor of using it as a predictor variable. Generalized logistic regression was used to estimate the probability distribution of potential grade as a function of species group, site index and dbh. Equations are presented for twenty species groups found in age-indeterminate stands of the northeastern United States. These will be incorporated into a regional growth and yield simulator.

Problem 3 **How the non-industrial private forest owner can evaluate forest management alternatives**
FY 92 Research Attainments

Publications

none

Attainment

No progress to report this period.

›rtheastern Forest Experiment Station
rest Environment Research
:search Work Unit 4251

ildlife Communities and Habitat Relationships in New England Forests
:Graaf, Richard M., Project Leader

FY 92 Research Attainments
Research Work Unit Summary

Problem number and title	Functional account	Current funding	Current staffing	Research Outputs		
				Research unit	Extra-mural	Cooper-ative
		thousand dollars	*scientist years*			
Wildlife community responses alternative silvicultural stems in northern hardwoods	FER	536	1.0	6		
Relationships between stand ructure and abundance of ammals in New England oak rests	FER	117	1.0	2		
Effects of forest management amphibians and amphibian bitats in a changing global virnment	FER	49	1.0			

Problem 1 **Wildlife community responses to alternative silvicultural systems in northern hardwoods**
FY 92 Research Attainments

Publications

Research Unit

DeGraaf, Richard M. 1991. Winter foraging guild structure and habitat associations in suburban bird communities. Landscape and Urban Planning. 21: 173-180.

DeGraaf, Richard M. 1992. Effects of even-aged management on forest birds at northern hardwood stand interfaces. Forest Ecology and Management. 47: 95-110.

DeGraaf, Richard M.; Geis, Aelred D.; Healy, Patricia A. 1991. Bird population and habitat surveys in urban areas. Landscape and Urban Planning. 21: 181-188.

DeGraaf, Richard M.; Snyder, Dana P.; Hill, Barbara J. 1991. Small mammal habitat associations in poletimber and sawtimber stands of four forest cover types. Forest Ecology and Management. 46: 227-242.

DeGraaf, Richard M.; Yamasaki, Mariko; Leak, William B.; Lanier, John W. 1992. New England wildlife: management of forested habitats. Gen. Tech. Rep. NE-144. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 271 p.

Welsh, Christopher J.E.; Capen, David E. 1992. Availability of nesting sites as a limit to woodpecker populations. Forest Ecology and Management. 48: 31-41.

Attainment

The breeding bird assemblages at stand interfaces of even-aged New England northern hardwood stands were identified. The proportions of edge-detected species were higher in the younger stand in all edge types except the most subtle edges between mature stands. Only across seedling-sawlog and sapling-large sawlog edges were bird assemblages more different than similar. Foliage profiles in stands of widely disparate ages are similar, and effects of boundaries between even-age stands are ephemeral. In a study of woodpecker populations and cavity tree abundance, nest site availability did not limit densities of 5 species of woodpeckers in New York northern hardwoods. A publication was developed that presents silvicultural treatments for 6 major cover type groups in New England to produce stand conditions that provide habitat opportunities for a wide range of species. It includes matrices of habitat use by forested and nonforested habitats, habitat breadth, size-class and structural habitat features for 338 species of wildlife.

Problem 2 **Relationships between stand structure and abundance of mammals in New England oak forests**
FY 92 Research Attainments

Publications

Research Unit

Healy, William M.; Welsh, Christopher J.E. 1992. Evaluating line transects to monitor gray squirrel populations. Wildlife Society Bulletin. 20 (1): 83-90.

Welsh, Christopher J.E.; Healy, William M.; DeGraaf, Richard M. 1992. Cavity-nesting bird abundance in thinned versus unthinned Massachusetts oak stands. Northern Journal of Applied Forestry. 9 (1): 6-9.

Attainment

Studies are continuing on the relationships between stand structure and wildlife abundance, and the interactions among acorn crops and populations of small mammals and deer. Squirrel density varied by almost 15 fold during a 5-year period when the acreage of squirrel habitat did not change. Gray squirrels have been selected as the indicator species for mature and old-growth oak communities in 7 of 15 eastern region National Forests. Squirrel populations may also serve as indicators of important ecosystem functions and the abundance of other less conspicuous species that depend on tree seeds. Line-transect sampling is useful for monitoring squirrel abundance on large areas. Evaluating the effects of management on squirrel populations will require repeated measures over 5 or more years. Thinning of oak stands has the potential to reduce cavity nesting bird populations by reducing the availability of trees suitable for nest-hole excavation and foraging. We found no difference in the abundance of cavity nesting birds between unthinned and thinned oak stands when snags and nest trees were retained during thinning. Intermediate cutting can be conducted without effecting the abundance of cavity-nesting birds if cavity trees are retained. The marking guides are simple and the effect on wood production is minimal.

Problem 3 **Effects of forest management on amphibians and amphibian habitats in a changing global envirnment**
FY 92 Research Attainments

Publications

none

Attainment

Studies were initiated to assess measurement techniques and sampling variability in amphibians and invertebrate populations of temporary ponds in north-central Massachusetts. In the period since mid-May, 1992, 28 vertebrate species were captured, including 12 amphibian, 2 reptile, and 14 mammal species. Of these, 1 amphibian is a state-listed Threatened species and 1 amphibian and 2 mammals are state-listed species of Special Concern. The use of drift-fences with associated pit-fall traps has proven useful for capturing amphibians and is being implemented on a larger scale and at a larger number of ponds. Two invertebrate sampling periods occurred in each of the temporary ponds. Each sample combined the use of dipnet and core samples at three locations. The samples have been initially processed, and are stored awaiting screening, identification, and enumeration. The pond basins and pond catchments have been surveyed and terrestrial vegetation has been sampled in each catchment.

Northeastern Forest Experiment Station
Forest Environment Research
Research Work Unit 4301

Water Resource Protection in Central Appalachian Forests
Adams, Mary Beth, Project Leader

FY 92 Research Attainments
Research Work Unit Summary

Problem number and title	Functional account	Current funding	Current staffing	Research Outputs		
				Research unit	Extra-mural	Cooper-ative
		thousand dollars	*scientist years*			
1. Minimizing hydrologic impacts of surface disturbances from forest access and harvest	FER	168	1.0	2		
2. Impact of atmospheric deposition on the soil and water resources of Appalachian forests	FER	563	2.0	6	3	8

Problem 1 **Minimizing hydrologic impacts of surface disturbances from forest access and harvest**
FY 92 Research Attainments

Publications

Research Unit

Edwards, Pamela J.; Kochenderfer, James N.; Seegrist, Donald W. 1991. Effects of forest fertilization on stream water chemistry in the Appalachians. Water Resources Bulletin. 27 (2): 265-274.

Kochenderfer, James N.; Edwards, Pamela J. 1991. Effectiveness of three streamside management practices in the central Appalachians. In: Coleman, Sandra S.; Neary, Daniel G., eds. Proceedings of the 6th biennial southern silvicultural research conference; 1990 October 30-November 1; Memphis, TN. Gen. Tech. Rep. SE-70. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station: 688-700.

Attainment

NE-4301 has broadened the scope of its research on effects of forest management beyond the traditional road and erosion research, for which it has received international recognition. The publication "Effects of forest fertilization on stream water chemistry in the Appalachians" documents increases in leaching of nitrate, calcium and magnesium after fertilization with ammonium nitrate and triple superphosphate. The effects of three silvicultural and streamside management practices on sediment loss, water temperature and nutrient export are detailed in "Effectiveness of three streamside management practices in the Central Appalachians". None of the silvicultural treatments significantly increased sediment yields, and water temperature was unaffected as long as stream side zones were only partially cut. To transfer what has been learned during many years of watershed research, an educational video entitled "Water in the Forest" was developed. The video, which was written by and starred NE-4301 personnel, complements the "Woodlot management" video series.

Problem 2 **Impact of atmospheric deposition on the soil and water resources of Appalachian forests**
FY 92 Research Attainments

Publications

Research Unit

Adams, M.B.; Edwards, P.J.; Kochenderfer, J.N. 1991. Watershed acidification on the Fernow Experimental Forest, West Virginia. In: Agronomy abstracts: 1991 annual meeting of the American Society of Agronomy, Crop Science Society of America, Soil Science Society of America; 1991 October 27-November 1; Denver, CO. Madison, WI: American Society of Agronomy: 345. Abstract.

Adams, Mary Beth; Nichols, Dale S.; Federer, C. Anthony; Jensen, Keith F.; Parrott, Harry. 1991. Screening procedure to evaluate effects of air pollution on Eastern Region wildernesses cited as class 1 air quality areas. Gen. Tech. Rep. NE-151. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 33 p.

Edwards, P.J.; Wood, F. 1992. The effects of watershed acidification on soil water and stream water chemistry. In: Proceedings of the 1992 spring meeting of the American Geophysical Union. Canadian Geophysical Union, and Mineralogical Society of America; 1992 May 12-16; Montreal, PQ. Washington, DC: American Geophysical Union: 121. Abstract.

Edwards, Pamela J.; Wood, Frederica; Kochenderfer, James N. 1991. Characterization of ozone during consecutive drought and wet years at a rural West Virginia site. Journal of the Air & Waste Management Association. 41 (11): 1450-1453.

Helvey, J. David; Kochenderfer, James N. 1991. Time trends in selected chemical characteristics of streamflow from an undisturbed watershed in West Virginia. In: Rennie, P.J.; Robitaille, G., eds. Effects of acid rain on forest resources: Proceedings of the conference; 1983 June 14-17; Sainte-Foy, PQ. Science and Sustainable Development Information Report DPC-X-35. Ottawa, ON: Environment Canada, Forestry Canada: 429-437.

Northeastern Forest Experiment Station; West Virginia University Extension Service. 1991. Water in the forest. Video. Radnor, PA: USDA Forest Service, Northeastern Forest Experiment Station. 23:40 min.

Cooperative

Adams, Mary Beth; Mattson, Kim G. 1992. Effects of nitrogen on carbon turnover in forests. Proceedings of the West Virginia Academy of Science. 64(1):27. Abstract.

Dubey, T.; Stephenson, S.L.; Edwards, P.J. 1991. A preliminary study of the mycoflora of West Virginia mountain streams. Mycological Society of America Newsletter 42:12. Abstract.

Dubey, Tara; Stephenson, Steven L.; Edwards, Pamela J. 1992. The effect of stream pH on the distribution patterns of aquatic fungi. Proceedings of the West Virginia Academy of Science. 64(1):14. Abstract.

Gilliam, Frank S.; Adams, Mary Beth. 1992. Stand structure and species composition of montane hardwood forests of West Virginia. Proceedings of the West Virginia Academy of Science. 64(1):29. Abstract.

Griffith, Michael B.; Perry, Sue A. 1991. Leaf pack processing in two Appalachian mountain streams draining catchments with different management histories. Hydrobiologia. 220: 247-254.

Griffith, Michael B.; Perry, Sue A. 1992. Plecoptera of headwater catchments in the Fernow Experimental Forest, Monongahela National Forest, West Virginia. Proceedings of the Entomological Society of Washington. 94 (2): 282-287.

Smith, Staci D.; Turrill, Nichole L.; Gilliam, Frank S.; Adams, Mary Beth. 1992. Herbaceous layer species composition, richness and diversity of a southern Appalachian mixed hardwood forest. Proceedings of the West Virginia Academy of Science. 64(1):34. Abstract.

Turrill, Nicole L.; Gilliam, Frank S.; Adams, Mary Beth. 1992. Response of harbaceous layer vegetation to elevation in a southern Appalachian hardwood forest. Proceedings of the West Virginia Academy of Science. 64(1):36. Abstract.

Extramural

Adams, Mary Beth; Eagar, Christopher. 1991. Effects of acidic deposition on high-elevation spruce-fir forests in the United States. In: Longhurst, James W.S., comp., ed. Acid deposition: origins, impacts and abatement strategies. New York, NY: Springer-Verlag: 75-91.

Eagar, Christopher; Adams, Mary Beth, eds. 1992. Ecology and decline of red spruce in the eastern United States. Ecological Studies 96. New York, NY: Springer-Verlag. 417 p.

Johnson, A.H.; McLaughlin, S.B.; Adams, M.B.; Cook, E.R.; DeHayes, D.H.; Eagar, C. 1992. Synthesis and conclusions from epidemiological and mechanistic studies of red spruce decline. In: Eagar, Christopher; Adams, Mary Beth, comps., eds. Ecology and decline of red spruce in the Eastern United States. Ecological Studies 96. New York, NY: Springer-Verlag: 385-411.

Attainment

Because West Virginia experiences high levels of atmospheric deposition, and because the state is approximately 85% forested, there is a great need for information on air pollution effects on forests. Ozone concentrations at a low elevation rural remote monitoring site were found to be sufficiently high that injury to forests could occur, and were attributed predominantly to long-range transport. A whole watershed manipulation project, designed to evaluate acidic deposition effects on forest ecosystems, is in its fifth year and has greatly contributed to increased knowledge about populations of invertebrates and aquatic fungi, detrital processing, vegetation dynamics and nutrient cycling. This information is vital for land managers, as well as policy-makers and general public. The publication, "Screening procedure to evaluate effects of air pollution on Eastern Region wildernesses cited as class 1 air quality areas", was developed using results of such research to assist National Forest land managers in making recommendations about permits for new or expanding industries near class 1 air quality areas, such as wildernesses.

Northeastern Forest Experiment Station
Forest Environment Research
Research Work Unit 4351

Enhancement of the Human Habitat Through Management of Natural Environments
Corbett, Edward S., Project Leader

FY 92 Research Attainments
Research Work Unit Summary

Problem number and title	Functional account	Current funding	Current staffing	Research Outputs		
				Research unit	Extra-mural	Cooper-ative
		thousand dollars	*scientist years*			
1. Improve guidelines for managing forests to modify microclimates for reducing stresses in human hab.	FER	0	.1			
2. Quantifying cumulative effects of atmospheric deposition, biotic factors and multiple use mgt.	FER	281	1.8	3		6
M1. Long-term watershed studies	FER	14	.1			

Problem 1 **Improve guidelines for managing forests to modify microclimates for reducing stresses in human hab.**
FY 92 Research Attainments

Publications

none

Attainment

The following reflects major accomplishments for the life of this problem. Trees and forests within or adjacent to human developments influence both microclimatic and acoustic environments in ways that can be beneficial to people, including energy conservation. By influencing solar radiation and wind, trees near houses increase or decrease energy use for heating and cooling, depending largely on tree size, species, and location. About $35 billion is spent each year to heat and cool single-family homes, so results of this research, along with dissemination of findings, can lead to important dollar savings nationwide. A review of the effect of structure of windbreaks on wind flow yielded guides to design windbreaks for building protection. A set of simulations were completed to explore the potential of windbreaks to derive guides for optimum energy-saving windbreak design. The results of computer simulations confirm studies by other methods that windbreaks can save 10% to 25% of the cost of heating residential buildings. In this study, heating costs savings ranged from 10% to 19% with windbreaks on the north and west. Windbreaks also save some energy for cooling air conditioned buildings in warm climates, but these savings were more modest. Air-conditioning savings would increase dramatically with shade trees close to a house. A red pine plantation strip was shown to reduce traffic noise by an amount (8 dBA) that equaled predicted attenuation by a 4-m wall 10 m from the highway. Technology transfer was by scientific journals, talks to international groups of arborists and windbreak managers, through newspaper and newsletter articles, and by correspondence with homeowners, urban foresters, noise control engineers, and developers.

Problem 2 **Quantifying cumulative effects of atmospheric deposition, biotic factors and multiple use mgt.**
FY 92 Research Attainments

Publications

Research Unit

Corbett, Edward S.; Lynch, James A. 1992. Best management practices and habitat protection on municipal watersheds. In: Changing and innovative strategies for environmental protection: Proceedings of the 1992 conference of the National Association of Environmental Professionals; 1992 May 6-8; Seattle, WA. Washington, DC: National Association of Environmental Professionals: 474. Abstract.

Corbett, Edward S. 1992. Status of water quantity and quality program: Forest Service Research. In: Blackburn, Wilbert H.; King, John G. eds. Water resource challenges in opportunities for the 21st century: Proceedings of the 7th USDA water resource research and technology transfer workshop; 1991 August 26-30; Denver, CO. ARS-101. Washington, DC: U.S. Department of Agriculture, Agricultural Research Service: 61-65.

(Copies of the Proceedings can be purchased from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161)

Davidson, Walter H.; Graves, Donald H.; Ringe, James M.; Cunningham, Thomas R. 1991. Performance of spot-seeded oaks and walnut on an eastern Kentucky minesoil. International Journal of Surface Mining and Reclamation. 5: 163-165.

Cooperative

Lynch, J.A.; Corbett, E.S.; Grimm, J.W. 1991. Enhancement of regional wet deposition estimates based on modeled precipitation inputs. In: NADP technical committee meeting: abstracts of papers; 1991 October 7-10; Philadelphia, PA. Fort Collins, CO: National Atmospheric Deposition Program: 7. Abstract.

Lynch, J.A.; Corbett, E.S.; Grimm, J.W.; Bowersox, V.C. 1991. SOX, NOX, and acid rain: is there a relationship? In: NADP technical committee meeting: abstracts of papers; 1991 October 7-10; Philadelphia, PA. Fort Collins, CO: National Atmospheric Deposition Program: 8. Abstract.

Lynch, James A.; Horner, Kevin S.; Grimm, Jeffrey W.; Corbett, Edward S. 1992. Atmospheric deposition: spatial and temporal variations in Pennsylvania–1991. University Park, PA: The Pennsylvania State University, Environmental Resources Research Institute; ER 9207A. 363 p.

(Contains specific chemical analyses, statistics, and maps.)

Lynch, James A.; Horner, Kevin S.; Grimm, Jeffrey W.; Corbett, Edward S. 1992. Atmospheric deposition: spatial and temporal variations in Pennsylvania–1991. University Park, PA: The Pennsylvania State University, Environmental Resources Research Institute; ER 9207. 100 p.

(An analysis of State-wide atmospheric deposition data)

Pollio, Carol A.; Davidson, Walter H. 1992. Native seed bank Brooklyn reclamation project. Park Science. 12 (1): 10-11.

Pollio, Carol A.; Davidson, Walter H. 1992. Native seed bank Brooklyn reclamation project. In: Proceedings New River Symposium; 1992 April 9-11; Beckley, WV. Glen Jean, WV: National Park Service, New River Gorge National River; West Virginia Department of Culture and History: 34-49.

Attainment

Precipitation volume measurements from existing networks and digital elevation data were used to develop a model to predict precipitation in Pennsylvania at any latitude and longitude. Based on precipitation/elevation relationships, the model was refined by incorporating slope/aspect parameters and a regional climatic submodel. The submodel enhanced precipitation estimates by considering prevailing climatic patterns. By combining modeled estimates of precipitation with NADP/NTN and Pennsylvania network precipitation chemistry using a surfacing algorithm, wet deposition can be estimated at any point in the State. A statistical analysis of predicted versus measured deposition showed that the modeled precipitation approach provides a much more reliable estimate of deposition that that available using estimates extrapolated from point measurements of wet deposition alone. Integrating this model with a geographic information system allows for more spatially reliable assessments of the impacts of wet atmospheric deposition on aquatic and terrestrial ecosystems. This approach has potential regional applications. The acidification of habitats has been suggested as one of the possible causes of the world wide decline in amphibian populations along with changing global conditions. Amphibians possess a range of characteristics that make them vulnerable to changing environmental conditions and also potential bioindicators of environmental change. Identifying measurable indicators for monitoring changes in environmental conditions will result in beneficial planning tools for future resource management decisions.

Problem M1 **Long-term watershed studies**
FY 92 Research Attainments

Publications

none

Attainment

These are long-term studies of the effects of vegetation conversion on hydrologic response. No activities other than data collection and maintenance were scheduled this year.

Northeastern Forest Experiment Station
Forest Environment Research
Research Work Unit 4352

Dymanics of Atmosphere, Vegetation, Soil & Water in Mature & Harvested Forests in New England
Eagar, Christopher, Project Leader

FY 92 Research Attainments
Research Work Unit Summary

Problem number and title	Functional account	Current funding	Current staffing	Research Outputs: Research unit	Research Outputs: Extra-mural	Research Outputs: Cooperative
		thousand dollars	*scientist years*			
1. To what degree do harvesting and/or acid precip. deplete nutrient capitals of New England	FER	418	2.6	4		2
2. What is the sequence of regeneration following conventional and intensive harvesting in forests	FER	56	.4			
3. How can we predict the progression of diameter growth for the major tree species in the Northeast	FER	1	.1	1		
4. What are the implications of highly acidic Cone Pond for understanding acidification of ecosystems	FER	202	.6	1		
5. Pathways of water and nutrient movement through forest soils. Can a useful model be developed?	FER	200	1.1			
M1. The HBEF will be maintained for ecosystem research biosphere reserve and for LTER	FER	325	1.5	3	5	4

Problem 1 **To what degree do harvesting and/or acid precip. deplete nutrient capitals of New England**
FY 92 Research Attainments

Publications

Research Unit

Harris, M.M.; Riha, S.J. 1991. Carbon and nitrogen dynamics in forest floor during short-term laboratory incubations. Soil Biology and Biochemistry. 23 (11): 1035-1041.

Hornbeck, James W. 1992. Comparative impacts of forest harvest and acid precipitation on soil and streamwater acidity. Environmental Pollution. 77: 151-155.

Hornbeck, James W.; Federer, C. Anthony. 1991. Acid rain and the buffer capacity of forest soils. In: Effects of Acid Rain on Forest Resources: Proceedings of the conference; 1983 June 14-17; Sainte-Foy, PQ. Ottawa, ON: Forestry Canada: 177-186.

Pardo, Linda H.; Li, Ching-Yan; Bormann, Bernard T.; Bormann, F. Herbert; Bowden, Breck W.; Pierce, Robert S.; Snyder, Michael C.; Wang, Deane. 1992. Associative nitrogen fixation in two experimental Pinus ecosystems. Bulletin of the Ecological Society of America 73 (2) (Suppl.): 295.

Cooperative

Adams, Mary Beth; Nichols, Dale S.; Federer, C. Anthony; Jensen, Keith F.; Parrott, Harry. 1991. Screening procedure to evaluate effects of air pollution on Eastern Region wildernesses cited as Class 1 air quality areas. Gen. Tech. Rep. NE-151. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 33 p.

Ryan, Douglas F.; Huntington, Thomas G.; Martin, C. Wayne. 1992. Redistribution of soil nitrogen, carbon and organic matter by mechanical disturbance during whole-tree harvesting in northern hardwoods. Forest Ecology and Management. 49: 87-99.

Attainment

Both atmospheric deposition and forest harvesting can acidify forest soils and streams. However, a study on a forested watershed in central Maine showed that of the two activities, atmospheric deposition has potential for causing more serious and long-lasting impacts. The study points out which soil characteristics place forests at risk to accelerated acidification, and shows that forest managers can moderate acidification rates by controlling harvest intensities. In a study of intensive forest harvesting, mechanically mixed soil under ruts and under mounds with mineral soil surface contained organic carbon and nitrogen pools significantly greater than undisturbed forest floors. Mechanical mixing into underlying mineral soil could account for the loss of forest floor observed after whole-tree clearcutting. Results of a study directed at understanding the timing and extent of the mechanisms which control the cycling of nitrogen in soils indicate that nitrogen mineralization rates vary with species composition of decomposing substract, and season of year. N mineralization was stimulated by additions of fresh carbon supplies. Removal of overstory prior to litterfall from whole tree harvest operations cold result in loss of a significant supply of the labile C necessary to release N and other essential nutrient elements. Designated Wilderness Areas of the northeastern U.S. are being impacted adversely by human-caused deposition of ozone, sulfuric acid, and nitric acid. Effects on both terrestrial and aquatic systems differ among the eight Wildernesses. Small lakes in New England Wilderness Areas have no acid-neutralizing capacity; additional deposition will acidify them further. Methods have been developed for screening by Region 9 National Forests of Prevention of Significant Deterioration permits. Prevention of Significant Deterioration permits.

Problem 2 **What is the sequence of regeneration following conventional and intensive harvesting in forests**
FY 92 Research Attainments

Publications

none

Attainment

Successful regeneration after harvesting is essential to sustaining the forest resources of New England. Recent trends in the Northeast have been towards greater mechanization of logging and more intense utilization of forest stands. Complete removal of the above-ground biomass associated with whole-tree harvesting has a profound effect on the forest floor environment. Exposure to direct solar radiation and dramatic reduction in transpiration coupled with the intrusion of heavy equipment affects the physical, chemical, and biological properties of the soil, which, in turn, affects regeneration. Knowledge is lacking about vegetation changes in natural forest stands particularly during the first 30 years after harvest. This information is critical to foresters and planners for choosing rotation lengths and future harvesting practices. This year data were collected from a 20-year old intensively harvested northern hardwood stands, and from a 10 year old central hardwood stand. These data will contribute to our understanding of the changes in forest structure, and biomass and nutrient accumulation during the first 20 years after intensive harvesting.

Problem 3 **How can we predict the progression of diameter growth for the major tree species in the Northeast**
FY 92 Research Attainments

Publications

Research Unit

Krusic, Paul J., Jr.; Hornbeck, James W. 1989. Preserving decayed wood samples for tree-ring measurement. Tree-Ring Bulletin. 49: 23-27.

Attainment

Tree-ring information can be obtained from fallen and standing dead trees for at least 29 years after death in northern New England forests. Treating decayed woody material by impregnation with wood glue renders samples strong enough to be surfaced and polished. Ring-width measurements as small as 0.01 mm can be made by the greatly improved visibility of individual xylem cells. Decayed red spruce disks treated by impregnation did not appreciably change in dimension. The use of this technique may be valuable to researchers looking to extend the length of existing chronologies, to study patterns of tree growth prior to death, and to date deteriorating architectural structures.

Problem 4 **What are the implications of highly acidic Cone Pond for understanding acidification of ecosystems**
FY 92 Research Attainments

Publications

Research Unit

Bailey, Scott W.; Hornbeck, James W. 1992. Lithologic composition and rock weathering potential of forested, glacial-till soils. Res. Pap. NE-662. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 7 p.

Attainment

The weathering potential of glacial-till was investigated on an acidic watershed (Cone Pond watershed in the White Mountains of New Hampshire) forested with mixed stands of northern hardwoods and conifers. Till material on the study watershed lacked minerals that buffer acidic deposition, and provide nutrients for tree growth. As a result, soils and streams were more acidic than on surrounding watersheds having nutrient-rich mineralogy, and soils appeared to be deficient in calcium, an important plant nutrient. Using this information as background for ecosystem management, this watershed would not be considered for intensive harvest. Soils are depleted of important plant nutrients, and rock weathering could not be relied upon to replace nutrients lost due to harvest and acidic deposition. Instead the recommendation would be for infrequent selection cuttings or recreational uses.

Problem 5 **Pathways of water and nutrient movement through forest soils. Can a useful model be developed?**
FY 92 Research Attainments

Publications

none

Attainment

Studies of chemical processes in upland forest soils require estimation of the rate of water movement downward through the soil profile. A new hydrologic model, called BROOK90, has been developed to assist in such estimates. The model is general and flexible. Surficial material, such as till, can be divided into as many layers as desired. Interception, snow accumulation and melt, evapotranspiration, and soil water movement are simulated using modern physically based algorithms and parameters. The model has been distributed to over 20 interested scientists in the U.S. and Europe, who will use it as a research tool in their own work. Research on the physical and chemical behavior of near stream, or source area, water is continuing in cooperation with the U.S. Geological Survey at the Cone Pond Experimental Watershed.

Problem M1 **The HBEF will be maintained for ecosystem research biosphere reserve and for LTER**
FY 92 Research Attainments

Publications

Research Unit

Eagar, Christopher; Adams, Mary Beth, eds. 1992. Ecology and decline of red spruce in the Eastern United States. New York, NY: Springer-Verlag. 417 p.

Hornbeck, James W.; Leak, William B. 1992. Ecology and management of northern hardwood forests in New England. Gen. Tech. Rep. NE-159. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 44 p.

Pierce, Robert S. 1991. The United States experience in using experimental watersheds in acid rain research. In: Effects of acid rain on forest resources: Proceedings of the conference; 1983 June 14-17; Sainte-Foy, PQ. Ottawa, ON: Forestry Canada: 353-354.

Cooperative

Dale, V.H.; Gardner, R.H.; DeAngelis, D.L.; Eagar, C.C.; Webb, J.W. 1991. Elevation-mediated effects of balsam woolly adelgid on southern Appalachian spruce-fir forests. Canadian Journal of Forest Research. 21 (11): 1639-1648.

Likens, Gene E. 1992. The ecosystem approach: its use and abuse. Excellence in Ecology 3. Oldendorf/Luhe, Germany: Ecology Institute. 166.

Schwartzman, T.; Smith, S.; DeGloria, S.; Martin, C.W. 1992. Design of a spatial information management system for long-term ecological research sites. In: Proceedings, 12th annual ESRI conference, Volume 1; 1992 June 8-12; Palm Springs, CA. Redlands, CA: Environmental Systems Research Institute, Inc.: 187-196.

Sendak, Paul E.; Tritton, Louise M.; Martin, C. Wayne. 1992. Interdisciplinary forest management. In: Maple syrup production: Proceedings of the North American Maple Syrup Council Technical Session; 1990 October 22; Batavia, NY. NRAES-62. Batavia, NY: Northeast Regional Agriculture Engineering Service: 20-29.

Extramural

Holmes, Richard T.; Sherry, Thomas W. 1992. Site fidelity of migratory warblers in temperate breeding and Neotropical wintering areas: implications for population dynamics, habitat selection, and conservation. In: Hogan, J.; Johnston, D.W., comps., eds. Ecology and conservation of Neotropical migrant landbirds. Washington, DC: Smithsonian Press: 563-575.

Holmes, Richard T.; Sherry, Thomas W.; Marra, Peter P.; Petit, Kenneth E. 1992. Multiple brooding and productivity of a neotropical migrant, the Black-throated Blue Warbler (Dendroica caerulescens), in an unfragmented temperate forest. The Auk. 109 (2): 321-333.

Rodenhouse, Nicholas L. 1992. Potential effects of climatic change on a neotropical migrant landbird. Conservation Biology. 6 (2): 263-272.

Rodenhouse, Nicholas L.; Holmes, Richard T. 1992. Results of experimental and natural food reductions for breeding Black-throated Blue Warblers. Ecology. 73 (1): 357-372.

Sherry, Thomas W.; Holmes, Richard T. 1992. Population fluctuations in a long-distance Neotropical migrant: demographic evidence for the importance of breeding season events in the American Redstart. In: Hogan, J.; Johnston, D.W., comps., eds. Ecology and conservation of Neotropical migrant landbirds. Washington, DC: Smithsonian Press: 431-442.

Attainment

Long-term data and information from the Hubbard Brook Experimental Forest were used to prepare a synthesis titled "Ecology and Management of Northern Hardwood Forests in New England." Information on traditional management tools such as stocking guides and yield tables are combined with ecological and hydrological knowledge to provide guidelines for harvesting northern hardwoods and for protecting stream-water quality, wildlife, and esthetics. The synthesis, written specifically for practicing foresters, landowners, managers, and planners, illustrates the variety of considerations that comprise present-day "ecosystem management." An automated spatial information management system was developed to document the nature and location of historical and contemporary field-based ecological research at Hubbard Brook Experimental Forest. The system was designed to provide a readily accessible, computerized spatial database to watershed managers and ecosystem scientists. Forest management activities must be planned using a holistic approach if forest manager's are to be able to assess the long-term ramifications of their activities. Features to be considered include: land-owner goals, description of the property, topography, geology, soils, current forest cover, habitat classification, recent insect and disease infestations, recent stand management, long-term land and forest history, and economic climate. A paper describing the use of GIS to plan and assess proposed forest management using a maple syrup operation in Vermont as a case study and using information from HBEF was prepared. Work is progressing in developing a monograph of the results of whole-tree clearcutting on the Hubbard Brook Experimental Forest and on the use of the acetylene reduction technique to study associative nitrogen fixation in plants.

Northeastern Forest Experiment Station
Forest Protection Research
Research Work Unit 4401

Interdisciplinary Approaches to Managing Northeastern Forest Ecosystems.
Tritton, Louise M., Project Leader

FY 92 Research Attainments
Research Work Unit Summary

Problem number and title	Functional account	Current funding	Current staffing	Research Outputs		
				Research unit	Extra-mural	Cooper-ative
		thousand dollars	*scientist years*			
1. Methodologies for integrating ecological and social dimensions of forest management	FER	124	.2	1		2
2. Application and evaluation of integrated approach to forest management problems.	FPR	139	1.4	2		

Problem 1 **Methodologies for integrating ecological and social dimensions of forest management**
FY 92 Research Attainments

Publications

Research Unit

Tritton, Louise; Parker, J. Kathy. 1992. Challenges to researchers as they integrate ecological and social dimensions of forest management. In: Book of abstracts: the 4th North American symposium on society and resource management; 1992 May 17-20; Madison, WI. Madison, WI: School of Natural Resources, Univ. of WI: 201-202. Abstract.

(This publication was an abstract for an oral presentation.)

Cooperative

More, Thomas; Tritton, Louise; Glass, Ronald. 1992. Moral dimensions of wildlife management. In: Book of abstracts: the 4th North American symposium on society and resource management: 1992 May 17-20; Madison, WI. Madison, WI: School of Natural Resources, Univ. of WI: 171-172. Abstract.

(This publication was an abstract for an oral presentation.)

Sendak, Paul E.; Tritton, Louise M.; Martin, C. Wayne. 1991. Interdisciplinary forest management. In: Maple syrup production: Proceedings of the North American Maple Syrup Council Technical Session; 1990 October; Batavia, NY. NRAES-62. Ithaca, NY: Northeast Regional Agricultural Engineering Service; 62: 20-29.

Attainment

FY92 was the first full year of our five year program. A review of international literature and an analysis of social science methodologies available for use in ecosystem research entitled "Integration of the social sciences into ecosystems research on small woodland management" were completed by cooperators. These two documents were used as the basis for initial conceptual work and a publication on "Challenges to researchers as they integrate ecological and social dimensions of forest management." We have written two cooperative agreements to further develop and test methodologies for monitoring and evaluating interdisciplinary research to guide us in our own interdisciplinary efforts. Other research institutions have requested this information. In addition, we are exploring ways to integrate moral values with ecosystem knowledge. We have given presentations on "The moral dimensions of wildlife management." We have written a cooperative agreement to develop strategies for integrating public values with ecosystem knowledge into National Forest management in NH and in OR.

Problem 2

Application and evaluation of integrated approach to forest management problems.
FY 92 Research Attainments

Publications

Research Unit

Wade, Gary L.; Thompson, Ralph L. 1992. Species richness on pre-SMCRA surface mines in Kentucky. In: Poster session abstracts: achieving land use potential through reclamation: 9th annual national meeting of the American Society for Surface Mining and Reclamation; 1992 June 14-18, Duluth, MN. Princeton, WV: American Society for Surface Mining and Reclamation: 20. Abstract.

(This publication was an abstract in a poster session.)

Wade, Gary L.; Thompson, Ralph L. 1991. Formula relates species richness and area to restoration success (Kentucky, Tennessee, Ohio, Virginia and West Virginia). Restoration and Management Notes. 9 (2): 124-125.

Attainment

FY92 was the first full year of our 5-year program. Studies in each area of emphasis were developed and cooperative agreements were written for the integrated approach to forest health. Ecological, pathological, silvicultural, historical, and economic data for a small northern hardwood forest were collected and entered into a Geographic Information System. A cooperative agreement was written to integrate the pathological and economic aspects of this work. We are in the process of synthesizing and evaluating the combined data. The scope of this problem and our approach are described in a publication entitled "Interdisciplinary Forest Management." For the integrated approach to plant species richness and management practices, we have developed species-area equations and tested them on reclaimed surface mines. We have begun to assemble published floras for areas ranging in size from a few hectares to counties and floristic regions, together with data on environmental characteristics of these areas. Regional and national data sets will be used to assess the influence of climatic variables on biodiversity. We have written three cooperative agreements to develop a broad database for this research.

Northeastern Forest Experiment Station
Forest Protection Research
Research Work Unit 4455

Northern Stations Global Change Research Program
Birdsey, Richard A. (PM), Project Leader

FY 92 Research Attainments
Research Work Unit Summary

Problem number and title	Functional account	Current funding	Current staffing	Research Outputs		
				Research unit	Extra-mural	Cooper-ative
		thousand dollars	*scientist years*			
1. Global Change Research	FPR	962	.6	3	23	2

Problem 1 **Global Change Research**
FY 92 Research Attainments

Publications

Research Unit

Birdsey, Richard A. 1992. Changes in forest carbon storage from increasing forest area and timber growth. In: Sampson, R. Neil; Hair, Dwight, comps., eds. Forest and Global Change, Volume 1: Opportunities for increasing forest cover. Washington, DC: American Forests: 23-39, 255-261.

Birdsey, Richard A. 1992. Impacts of forest management policy on carbon storage in U.S. forests. In: Adams, Darius; and others, eds. Forest sector, trade and environmental impact models: theory and applications; 1992 April 30-May 1; Seattle, WA. Seattle, WA: Center for International Trade in Forest Products: 70-77.

Birdsey, Richard A.; Schreuder, Hans T. 1992. An overview of forest inventory and analysis estimation procedures in the Eastern United States – with an emphasis on the components of change. Gen. Tech. Rep. RM-214. Fort Collins, CO: Rocky Mountain Forest and Range Experiment Station. 11 p.

Cooperative

Fosberg, Michael A.; Joyce, Linda A.; Birdsey, Richard A. 1992. Global change and forest resources: modeling multiple forest resources and human interactions. In: Reilly, John M.; Anderson, Margot, comps., eds. Economic issues in global climate change. Boulder, CO: Westview Press: 235-251.

Radloff, David; Loomis, Robert; Barnard, Joseph; Birdsey, Richard. 1991. Forest health monitoring: taking the pulse of America's forests. In: Agriculture and the environment. The 1991 Yearbook of Agriculture. Washington, DC: U.S. Department of Agriculture, Forest Service: 41-47.

Extramural

Alscher, Ruth Grene; Madamanchi, Nageswara Rao; Cramer, Carole L. 1991. Protective mechanisms in the chloroplast stroma. In: Pell, E.; Steffen, K., comps., eds. Active oxygen/oxidative stres and plant metabolism. Rockville, MD: American Society of Plant Physiologists: 145-155.

Bailey, Scott W.; Hornbeck, James W. 1992. Lithologic composition and rock weathering potential of forested, glacial-till soils. Res. Pap. NE-662. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 7 p.

Boyce, Richard L.; Friedland, Andrew J.; Webb, Elizabeth T.; Herrick, Graham T. 1991. Modeling the effect of winter climate on high-elevation red spruce shoot water contents. Forest Science. 37 (6): 1567-1580.

DeHayes, D.H.; Hawley, G.J. 1992. Genetic implications in the decline of red spruce. Water, Air, and Soil Pollution. 62: 233-248.

Eagar, Christopher; Adams, Mary Beth, eds. 1992. Ecology and decline of red spruce in the Eastern United States. Ecological Studies 96. New York, NY: Springer-Verlag. 417.

Feldman, S.B.; Zelazny, L.W.; Baker, J.C. 1991. High-elevation forest soils of the southern Appalachians: I. distribution of parent materials and soil-landscape relationships. Soil Science Society of America Journal. 55 (6): 1629-1637.

Friedland, Andrew J.; Boyce, Richard L.; Webb, Elizabeth T. 1992. Winter and early spring microclimate of a subalpine spruce-fir forest canopy in central New Hampshire. Atmospheric Environment. 26A (7): 1361-1369.

Friedland, Andrew J.; Miller, Eric K.; Battles, John J.; Thorne, James F. 1991. Nitrogen deposition, distribution and cycling in a subalpine spruce-fir forest in the Adirondacks, New York, USA. Biogeochemistry. 14: 31-55.

Gage, Stephen F.; DeHayes, Donald H. 1992. Variation in seasonal patterns of photosynthesis among red spruce and balsam fir provenances. In: DeHayes, Donald H.; Hawley, Gary J., eds. Proceedings of the 1st northern forest genetics association conference; 1991 July 23-25; Burlington, VT. Burlington, VT: The University of Vermont: 109-120.

Grigal, D.F.; Ohmann, L.F. 1992. Carbon storage in upland forests of the Lake States. Soil Science Society of America Journal. 56 (3): 935-943.

Gupta, Ashima Sen; Alscher, Ruth Grene; McCune, Delbert C. 1990. Ozone exposure, glutathione levels and photosynthesis in hybrid poplar. In: Rennenberg, H.; and others, comps., eds. Sulfur nutrition and sulfur assimilation in higher plants. The Hague, Netherlands: SPB Academic Publishing: 195-197.

Li, Zheng; Aneja, Viney P. 1992. Regional analysis of cloud chemistry at high elevations in the eastern United States. Atmospheric Environment. 26A (11): 2001-2017.

Nater, E.A.; Grigal, D.F.; Ohmann, L.F.; David, M.B. 1992. Atmospheric deposition: evidence in forest ecosystems. Minnesota Agricultural Exp. Sta. Scientific Series #19373. St. Paul, MN: University of Minnesota. 117-126.

Nater, Edward A.; Grigal, David F. 1992. Regional trends in mercury distribution across the Great Lakes states, north central USA. Nature. July; 358: 139-141.

Peart, David R.; Jones, Matthew B.; Palmiotto, Peter A. 1991. Winter injury to red spruce at Mount Moosilauke, New Hampshire. Canadian Journal of Forest Research. 21: 1380-1389.

Preece, John E.; Navarrete, Nadia; Van Sambeek, J.W.; Gaffney, Gerald R. 1991. An in vitro microplant bioassay using clonal white ash to test for tall fescue allelopathy. Plant Cell. 27: 203-210.

Reed, David D.; Desanker, Paul V. 1992. Ecological implications of projected climate change scenarios in forest ecosystems in northern Michigan, USA. International Journal of Biometeorology. 36: 99-107.

Rowntree, Rowan A.; Nowak, David J. 1991. Quantifying the role of urban forests in removing atmospheric carbon dioxide. Journal of Arboriculture. 17 (10): 269-275.

Showman, R.E.; Long, R.P. 1992. Lichen studies along a wet sulfate deposition gradient in Pennsylvania. The Bryologist. 95 (2): 166-170.

Tobi, Donald R.; Leonard, Jonathan G.; Parker, Bruce L.; Wallner, William E. 1992. Survey methods, distribution, and seasonality of Korscheltellus gracilis (Lepidoptera: Hepialidae) in the Green Mountains, Vermont. Environmental Entomology. 21 (3): 447-452.

Waite, Carl E.; DeHayes, Donald H. 1992. Developmental cold tolerance of red spruce and balsam fir provenances. In: DeHayes, Donald H.; Hawley, Gary J., eds. Proceedings of the 1st northern forest genetics association conference; 1991 July 23-25; Burlington, VT. Burlington, VT: The University of Vermont: 99-108.

Wilkinson, Ronald C. 1992. Variation in needle characteristics and transpiration of red spruce and seedling progeny from high and low elevation stands in northern Vermont. In: DeHayes, Donald H.; Hawley, Gary J., eds. Proceedings of the 1st northern forest genetics association conference; 1991 July 23-25; Burlington, VT. Burlington, VT: The University of Vermont: 78-98.

Zipperer, Wayne C.; Andersen, Carol G. 1991. An assessment of residential development in a rural community. In: Technical papers 1991 ACSM-ASPRS annual convention. Volume 4: GIS; 1991; Baltimore, MD. Bethesda, MD: American Congress on Surveying and Mapping and the American Society for Photogrammetry and Remote Sensing: 257-263.

Attainment

Completed 2 rounds of requests for proposals and selection of basic research studies at physiology and ecosystem levels, which will provide the foundation of understanding ecosystem responses to global change. Initiated several landscape and modeling studies to interpret results at ecosystem and regional scales. Several additional landscape and modeling studies will be initiated next year to complete the research necessary to prepare a major assessment of the effects of global change on forests and people in the North by 1955. Few new research results have been completed; however, the program has brought to completion much research initiated under the previous Forest Response Program and summarized in a book titled "Ecology and Decline of Red Spruce in the Eastern United States". The major publication summarized the current state of knowledge about spruce-fir ecology and response to air pollution. At the policy level, a carbon budget model for U.S. forests has been completed and used to develop the U.S. accounting system for carbon dioxide reductions. The model has shown historical increases in carbon sequestering in U.S. forests, and the potential for future increases but at a slower rate without additional policy and forest management incentives.

Northeastern Forest Experiment Station
Forest Protection Research
Research Work Unit 4501

Ecology and Management of Northeastern Hardwood Insect Pests
Montgomery, Michael E., Project Leader

FY 92 Research Attainments
Research Work Unit Summary

Problem number and title	Functional account	Current funding	Current staffing	Research Outputs		
				Research unit	Extra-mural	Cooper-ative
		thousand dollars	*scientist years*			
1. Knowledge of factors governing susceptibility of trees to defoliation and methods to predict	FPR	193	1.0	2		5
2. Use of genetics, physiology & ecology to enhance biorational methods to manage gypsy moth populati	FPR	444	2.5	6		4
3. Reduce likelihood of establishment of Asian race of gypsy moth in North America	FPR	446	2.2	4		
4. Influence of UV-B radiation on the balance between trees and their pests	FPR	114	.2			
5. Develop a biological control problem to reduce populations of hemlock woolly adelgid	FPR	48	.1			

Problem 1 **Knowledge of factors governing susceptibility of trees to defoliation and methods to predict**
FY 92 Research Attainments

Publications

Research Unit

Montgomery, Michael E. 1990. Role of site and insect variables in forecasting defoliation by the gypsy moth. In: Watt, A.D.; Leather, S.R.; Hunter, M.D.; Kidd, N.A.C., comps., eds. Population dynamics of forest insects. Andover, UK: Intercept, Ltd.: 73-84.

ODell, Tom. 1992. Establishing and providing resources for municipal forest and/or shade tree committees. The Habitat. 11 (2): 11.

Cooperative

Schultz, Jack C. 1989. Tannin-insect interactions. In: Hemingway, Richard W.; Karchesy, Joseph J., comps., eds. Chemistry and significance of condensed tannins. New York, NY: Plenum Press: 417-433.

Schultz, Jack C.; Foster, Michael A.; Montgomery, Michael E. 1990. Host plant-mediated impacts of a baculovirus on gypsy moth populations. In: Watt, A.D.; Leather, S.R.; Hunter, M.D.; Kidd, N.A.C., comps., eds. Population dynamics of forest insects. Andover, UK: Intercept, Ltd.: 303-316.

Talhouk, Salma K.; Nielsen, David G.; Montgomery, Michael E. 1990. Water deficit, defoliation, and birch clones: short-term effect on gypsy moth (Lepidoptera: Lymantriidae) performance. Environmental Entomology. 19 (4): 937-942.

Werren, John H.; Raupp, Michael J.; Sadoff, Clifford S.; ODell, Thomas M. 1992. Host plants used by gypsy moths affect survival and development of the parasitoid Cotesia melanoscela. Environmental Entomology. 21 (1): 173-177.

Witter, John A.; Chilcote, Charley A.; Stoyenoff, Jennifer L.; Montgomery, Michael E. 1992. Host relationships of gypsy moth in aspen and oak stands: management implications. In: Proceedings of the national gypsy moth review; 1990 October 23-25; Ottawa, ON. [Place of publ. unknown]: [Publisher name unknown]: 63-74.

Attainment

Several independent studies showed how various biotic and abiotic factors acting through the host plant influence the population dynamics of the gypsy moth. Stress on the plant such as soil moisture deficits and defoliation was found to influence the food quality of foliage. The effectiveness of parasites & disease of the gypsy moth was influenced by the host plant on which the larvae fed. The suitability of mixed oak-aspen stands was contrasted with pure stands & it was shown how survivorship and fecundity could be higher in a mixed stand. Much of this and historical information was integrated into models to forecast defoliation by the gypsy moth. These models show that using only estimates of population density gives unreliable predictions of defoliation, but the accuracy of predictions is improved greatly when variables that consider site characteristics and population quality are included in the model.

Problem 2 **Use of genetics, physiology & ecology to enhance biorational methods to manage gypsy moth populati**
FY 92 Research Attainments

Publications

Research Unit

Montgomery, Michael E. 1992. A charter for the Gypsy Moth Research & Development Program. In: Souto, D.J., comp. Proceedings of the 24th annual Northeastern Forest Insect Work Conference; 1992 March 4-6; Albany, NY. [Place of publ. unknown]: [Publisher name unknown]: 37-39.

Montgomery, Michael E. 1992. Why are gypsy moth numerical dynamics so irregular in North America?. In: Allen, Douglas C.; Abrahamson, Lawrence P., eds. Proceedings: North American Forest Insect Work Conference; 1991 March 25-28; Denver, CO. Gen. Tech. Rep. PNW-GTR-294. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 34-35.

Montgomery, Michael E. 1992. Why is the gypsy moth doing so well in North America?. In: Allen, Douglas C.; Abrahamson, Lawrence P., eds. Proceedings: North American Forest Insect Work Conference; 1991 March 25-28; Denver, CO. Gen. Tech. Rep. PNW-GTR-294. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 73.

ODell, Thomas M., comp. 1991. Proceedings of the 23rd annual Northeastern Forest Insect Work Conference; 1990 March 8-9; Albany, NY. Syracuse, NY: College of Environmental Science & Forestry, State University of New York. 43 p.

Shields, Kathleen S. 1992. Ultrastructure of gypsy moth (Lymantria dispar) nephrocytes. In: Bailey, G.W., ed. Proceedings, 50th annual meeting Electron Microscopy Society of America 1992; 1992 August 16-20; Boston, MA. San Francisco, CA: San Francisco Press: 922-923.

Wallner, William E.; Wagner, David L.; Parker, Bruce L.; Tobi, Donald R. 1991. Bioecology of the conifer swift moth, Korscheltellus gracilis, a root feeder associated with spruce-fir decline. In: Baranchikov, Yuri N.; Mattson, William J.; Hain, Fred P.; Payne, Thomas L., eds. Forest insect guilds: patterns of interaction with host trees; 1989 August 13-17; Abakan, Siberia, USSR. Gen. Tech. Rep. NE-153. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 199-204.

Cooperative

Elkinton, J.S.; Gould, J.R.; Ferguson, C.S.; Liebhold, A.M.; Wallner, W.E. 1990. Experimental manipulation of gypsy moth density to assess impact of natural enemies. In: Watt, A.D.; Leather, S.R.; Hunter, M.D.; Kidd, N.A.C., comps., eds. Population dynamics of forest insects. Andover, UK: Intercept, Ltd.: 275-288.

Gould, Juli R.; Elkinton, Joseph S.; ODell, Thomas M. 1992. Superparasitism of gypsy moth, Lymantria dispar (L.) (Lepidoptera: Lymantriidae), larvae by Parasetigena silvestris (Robineau-Desvoidy) (Diptera: Tachinidae). The Canadian Entomologist. 124 (3): 425-436.

Moore, Karen E.B.; Jones, Clive G. 1992. Estimating field hatch of gypsy moth (Lepidoptera: Lymantriidae). Environmental Entomology. 21 (2): 276-280.

Stanley-Samuelson, David W.; ODell, Thomas M.; Ogg, Clyde L.; Keena, Melody A. 1992. Polyunsaturated fatty acid metabolism inferred from fatty acid compositions of the diets and tissues of the gypsy moth, Lymantria dispar. Comparative Biochemistry and Physiology. 102A (1): 173-178.

Attainment

Ultrastructural examination of the internal anatomy of gypsy moth revealed the existence of nephrocytes at the junction of the foregut and midgut. These cells seem to be involved in the uptake of many active substances and damage of cells may increase permeability of the gut to pathogens. The fatty acid composition of the gypsy moth and its diet was clarified. The gypsy moth is able to synthesize essential long-chain fatty acids; decomposition of fatty acids in artificial diet was minimal and does not seem to affect diet quality. The source and type of mineral salts in the artificial diet was found to significantly influence diet quality. Factors that lead to population stabilization on a spatial scale and instability on a temporal scale were examined. Small mammal predation and recruitment of generalist parasites tend to keep populations at very low levels. This in turn can lead to instability in density-dependent population regulation. Density-dependent regulation seems much weaker in North American than in European populations of gypsy moth.

Problem 3 **Reduce likelihood of establishment of Asian race of gypsy moth in North America**
FY 92 Research Attainments

Publications

Research Unit

Culliney, Thomas W.; ODell, Thomas M.; Sanchez, Vincente. 1992. Larviposition of Compsilura concinnata (Meigen) (Diptera: Techinidae), a parasitoid of the gypsy moth, Lymantria dispar (L.) (Lepidoptera: Lymantriidae). Biocontrol Science and Technology. 2: 65-67.

(Senior author is a former NEFES employee now working for the State of Hawaii, Department of Agriculture, Honolulu, HI.)

Tkacz, Borys M.; Wallner, William E.; Goheen, Donald; Housley, Robert D.; Orr, Richard L.; Fons, James. 1991. Pest risk assessment of the importation of larch from Siberia and the Soviet Far East. Misc. Publ. 1495. Washington, DC: U.S. Department of Agriculture, Forest Service. 280 p.

Wallner, William. 1991. Organisms posing risk. In: Pest risk assessment of the importation of larch from Siberia and the Soviet Far East. Misc. Publ. 1495. Washington, DC: U.S. Department of Agriculture, Forest Service: 4-1 - 4-6.

Wallner, W.E. 1991 "Dr. Bill Wallner on the Asian gypsy moth". A 22-minute video describing the introduction and planned control efforts on this new gypsy moth race; B&B Productions, Inc. Guilford, CT.

Attainment

Mitochondrial DNA markets were developed and used to identify the ancestry of male moths caught in pheromone traps in the Pacific Northwest. Field studies in the Russian Far East on flight behavior obtained information on the attractancy of synthetic lures and the calling periodicity of females and ovipositional behavior. Attractancy to black light, sodium vapor, mercury, and tungsten electric lamps was also tested. Studies of genetic compatibility of North American and Asian populations was initiated. Protocols for testing the suitability of Pacific Northwest host plants were established. Models to predict the development rate of Asian gypsy moth were constructed. Because the Asian gypsy moth was a new introduction and emergency actions needed to be taken to eradicate it, considerable effort was made to transfer information obtained from previous studies in Asia to state, federal, and foreign governments and to the general public.

Problem 4 **Influence of UV-B radiation on the balance between trees and their pests**
FY 92 Research Attainments

Publications

none

Attainment

Oak seedlings were exposed to artificial UV-B radiation from fluorescent tubes for a period of 5 days. Compared to unexposed controls, no effect on the suitability of the foliage as food for gypsy moth larvae was observed for red oak, but consumption of white oak foliage was enhanced by UV-B irradiation. The distribution and transfer of UV-B in relation to PAR in hardwood forests is being determined by experimental measurements and models.

Problem 5 **Develop a biological control problem to reduce populations of hemlock woolly adelgid**
FY 92 Research Attainments

Publications

none

Attainment

Several potential predators of Adelges tsugae were found in colonies of Pineus strobi, the pine bark adelgid. Two of these, a fly in the genus Leucopis, and a beetle in the genus Lariocobius, were introduced as larvae and adults to colonies of A. tsugae. Larvae of both predators fed on the eggs of A. tsugae and matured to adults. The ovipositional behavior of these predators on A. tsugae is being evaluated. Several native species of syrphids and coccinelids that feed on aphids and/or scale insects would oviposit on A. tsugae, but their larvae were not able to complete development.

Northeastern Forest Experiment Station
Forest Protection Research
Research Work Unit 4502

Pathology and Microbial Control of Insects Defoliating Eastern Forest Trees
McManus, Michael L., Project Leader

FY 92 Research Attainments
Research Work Unit Summary

Problem number and title	Functional account	Current funding	Current staffing	Research Outputs		
				Research unit	Extra-mural	Cooper-ative
		thousand dollars	*scientist years*			
1. Develop the technology needed to optimize the use of Bt to protect forests from defoliating insects	FPR	446	1.2	7	2	3
2. Improve production, enhance activity, and optimize the application of GYPCHEK against the GM	FPR	291	1.0	4		6
3. The effect of Bt application on the distribution and abundance of non-target Lepidoptera in forests	FPR	195	1.0	1		
4. Introduce/establish exotic pathogens i.e. microsporidia to enhance natural control of GM.	FPR	97	.5		1	
M1. Develop and evaluate integrated pest management (IPM) strategies to manage the gypsy moth.	FPR	45	.2	1	5	3

Problem 1 **Develop the technology needed to optimize the use of Bt to protect forests from defoliating insects**
FY 92 Research Attainments

Publications

Research Unit

Dubois, N.R., Dean, D.H. 1991. Synergism between the insecticidal crystal proteins (ICP) of Bacillus thuringiensis encoded by the cryIA genes and Bacillus Species Spores and non-spore forming bacteria against the gypsy moth, Lymantria dispar L. In: Programs & Abstracts XXV Annual Meeting of the Society for Invertebrate Pathology; 1992 August 16-21; Heidelberg, Germany. Abstract.

Dubois, N.R., Dean, D.H., Wolfersberer, M.G. 1991. Larvacidal activity against the gypsy moth, Lymantria dispar L. of the Insecticidal Crystal Proteins (ICPs) encoded by the cryIA genes of Bacillus thuringiensis spores. In: XXIV Annual Meeting, Society for Invertebrate Pathology; 1991 Aug 4-6; Flagstaff, AZ. Abstract.

Dubois, Normand R.; McLane, Winfred. 1992. Comparative efficacy of Bacillus thuringiensis, Foray 48B, applied by mist blower or hydraulic sprayer on small blocks infested with gypsy moth. In: Proceedings of the national gypsy moth review; 1991 November 4-7; Raleigh, NC. Raleigh, NC: National Gypsy Moth Management Board: 125-128.

Dubois, Normand R.; Reardon, Richard; Mierzejewski,Karl; McLane, Winfred; Witcosky, Jeffrey R. 1991. Field efficacy of Bacillus thuringiensis Foray 48B and Thuricide 48LV when applied against young, (instar I-II) and older (instar III-IV), gypsy moth larval infestations. In: Proceedings of the national gypsy moth review; 1991 November 4-7; Raleigh, NC. Raleigh, NC: National Gypsy Moth Management Board: 129-132.

McManus, M.L. 1992. Future of microbial pesticides. In: Allen, Douglas C.; Abrahamson, Lawrence P.; tech. eds. Proceedings: North American forest insect work conference; 1991 March 25-28; Denver, CO. Gen. Tech. Rep. PNW-294. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 98-103.

(Invited presentation)

McManus, Michael L. 1992. Limitations to the development of microbial pesticides. In: Proceedings of the national gypsy moth review; 1991 November 4-7; Raleigh, NC. Raleigh, NC: National Gypsy Moth Management Board: 23-27.

(Invited paper)

McManus, Michael L. 1992. Microbial insecticides. In: Proceedings of the 24th annual Northeastern forest insect work conference; 1992 March 4-6; Albany, NY. Syracuse, NY: College of Environmental Science & Forestry, State University of New York: 42-44.

Cooperative

Miller, D.R.; Yendol, W.G.; McManus, M.L. 1992. On the field sampling of pesticide spray distributions using Teflon spheres and flat cards. Journal of Environmental Science and Health. B27 (2): 185-208.

Reardon, Richard C.; McLane, Winfred; Roland, Timothy; Mierzejewski, Karl; Yendol, William; Kenney, Patti. 1992. Characterization of lateral spray deposit using two aerially applied formulations of Bacillus thuringiensis. NA-TP-05-92. Radnor, PA: U.S. Department of Agriculture, Forest Service, Appalachian Integrated Pest Management. 1-49.

Wang, Y.; Miller, D.R.; Anderson, D.E.; Yendol, W.G.; Mierzejewski, K.; McManus, M.L. 1991. A Langrangian Modelling of aerial spray dispersion in an oak forest. In: Preprint 20th Conference on Agriculture and forest meteorology of the American Meteorological Society.; Salt Lake City, UT. 158-160.

Extramural

Duan, Baozhong; Yendol, William G.; Mierzejewski, Karl. 1992. Statistical comparison of the AGDISP model with deposit data. Atmospheric Environment. 26A (9): 1635-1642.

Onken, Amy; Reardon, Richard C.; Mierzejewski, Karl. 1991. The swath kit: a new aircraft characterization tool. NA-TP-02-91. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Area State and Private Forestry. 2 p.

Attainment

Results of lab bioassays indicated that two commercial formulations of Bt can be efficacious against 3rd and 4th instar gypsy moth larvae when applied at a higher dose. Previously, Bt has been recommended only against 1st and 2nd instar larvae, thus constricting the time frame or "window" for application in operational programs. 1991–1992 field studies confirmed that FORAY 48B applied at 36 BIU's in 96 oz./A. against 3rd and 4th instar larvae significantly reduced larval densities below the densities observed in the controls. Resource Managers now have the option of extending the "spray window" for applying Bt by adjusting the dose to larval development. A coop study was initiated with Forestry Canada to develop an in-vivo technique to measure Bt deposits on foliage using bioassay and immunoassay methods. Initial deposits, expressed in IU's/cm2, were lower in spray blocks that received lower volumes. The bioactivity of Bt persisted for less than 1 week, while the half-life of inactivation (DT50) varied from 12-22 hrs. This method shows promise as a replacement for other indirect methods (dye washoff) that are less accurate.

Problem 2 **Improve production, enhance activity, and optimize the application of GYPCHEK against the GM**
FY 92 Research Attainments

Publications

Research Unit

McManus, Michael L. 1992. Gypsy moth management in the United States. In: Allen, Douglas C.; Abrahamson, Lawrence P., tech. eds. Proceedings: North American forest insect work conference; 1991 March 25-28; Denver, CO. Gen. Tech. Rep. PNW-294. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 123-124.

Podgwaite, John D. 1992. Gypchek: Why the shortfall?. In: Proceedings of the national gypsy moth review; 1991 November 4-7; Raleigh, NC. Raleigh, NC: National Gypsy Moth Management Board: 28-29.

Podgwaite, John D.; Reardon, Richard C. 1992. Gypchek evaluated at low dosage and volume. In: Proceedings of the national gypsy moth review; 1991 November 4-7; Raleigh, NC. Raleigh, NC: National Gypsy Moth Management Board: 115-116.

Podgwaite, John D.; Reardon, Richard C.; Walton, Gerald S.; Venables, Lee; Kolodny-Hirsch, Douglas M. 1992. Effects of aerially applied Gypchek on gypsy moth (Lepidoptera: Lymantriidae) populations in Maryland woodlots. Journal of Economic Entomology. 85 (4): 1136-1139.

Cooperative

Keating, S.T.; Elkinton, J.S.; Burand, J.P.; Podgwaite, J.D.; Ferguson, C.S. 1991. Field evaluation of a DNA hybridization assay for nuclear polyhedrosis virus in gypsy moth (Lepidoptera: Lymantriidae) larvae. Journal of Economic Entomology. 84 (4): 1329-1333.

Reardon, R.C., Podgwaite, J.D., Cunningham, J.C. 1992. Advances in application methods, formulation and use-strategies for gypsy moth virus. In: Programs & Abstracts, XXV Annual Meeting Society for Invertebrate Pathology; 1992 August 16-21; Heidelberg, Germany. Abstract.

Reardon, Richard; Podgwaite, John. 1992. The gypsy moth Nucleopolyhedrosis virus product. NA-TP-02-92. Radnor, PA: U.S. Department of Agriculture, Forest Service, Appalachian Integrated Pest Management. 1-9.

Slavicek, James M.; Podgwaite, John; Lanner-Herrera, Carita. 1992. Properties of two Lymantria dispar nuclear polyhedrosis virus isolates obtained from the microbial pesticide Gypchek. Journal of Invertebrate Pathology. 59: 142-148.

Webb, R.E., Shapiro, M., Podgwaite, J.D. 1992. Field confirmation of potentiation of a baculovirus by an optical brightener. In: Programs and Abstracts, XXV Annual Meeting Society for Invertebrate Pathology; 1992 August 16-21; Heidelberg, Germany. Abstract.

Yu, Zalin; Podgwaite, John D.; Wood, H. Alan. 1992. Genetic engineering of a Lymantria dispar nuclear polyhedrosis virus for expression of foreign genes. Journal of General Virology. 73: 1509-1514.

Attainment

The availability and operational use of the viral pesticide Gypchek has been limited by a lack of commercial producer and for the need of a commercially availabile formulation. Recently, several experimental formulations of Gypchek have been made available to the FS through collaborative efforts with NOVO NORDISK and American Cyanamid Corp. Spray-tower bioassays indicate that at least two of these formulations performed as well against gypsy moth larvae as the standard Gypchek tank mix; consequently these products were tested on 30A. plots in western PA. Preliminary results indicate that good foliage protection and population reduction were obtained. Although further testing and methods development activities are needed, this breakthrough should greatly enhance interest and the ultimate availability of this safe viral pesticide. A Gypchek formulation containing a commercial "brightener" (UV absorber) was applied with a hydraulic sprayer on small (1/10A.) plots in W.VA. and MD in cooperation with ARS scientists. In lab bioassays, this "brightener" appears to enhance the activity of Gypchek, thus a smaller dose of the virus can be used with comparable results, and the cost of an acre-equivalent is reduced. Results from this year's field study confirm that good results can be obtained with a reduced dose of Gypchek and the "brightener."

Problem 3 **The effect of Bt application on the distribution and abundance of non-target Lepidoptera in forests**
FY 92 Research Attainments

Publications

Research Unit

Peacock, John W. 1992. Effects of Bacillus thuringiensis (Bt) on non-target Lepidoptera. In: Proceedings of the 24th annual Northeastern forest insect work conference; 1991 March 4-6; Albany, NY. Syracuse, NY: College of Environmental Science & Forestry, State University of New York: 40-41.

Attainment

Because of growing concern by the environmental community about the increased use of Bt products for forest protection, a program of research has been initiated to evaluate the impact of a commercial Bt formulation against non-target species of Lepidoptera. Laboratory bioassays were conducted to test a field dose of Foray 48B (36 BIU/A) against ca. 30 species of Lepidoptera known to inhabit mixed oak forests during the time operational spray programs normally commence. Contrary to the belief that Bt adversely affects all larval Lepidoptera, results indicate that there is wide variability in susceptibility among species. Although both early and late larval stages of some species were susceptible to Bt infection, larval stages of other species were unaffected. A field study was initiated in 1991 in Rockbridge, Co., VA. to measure the impact of Bt (Foray 48B), on non-target Lepidoptera present in the plots. Intensive larval sampling was conducted in three strata of the forest to acquire baseline data on the presence and abundance of larval Lepidoptera. Several thousand larvae were collected, photographed and reared to adults in order to facilitate their identification. In 1992, Foray 48B was applied to one-half of the blocks; over 12,000 larvae including more than 34 species of microlepidoptera and 9 species of macrolepidoptera have been reared and identified from samples taken within the treatment and control blocks to assess the short-term impact of Bt. This information is critical to resource managers who make decisions regarding the cost/benefit of aerial spraying and are concerned about its impact on biological diversity.

Problem 4 **Introduce/establish exotic pathogens i.e. microsporidia to enhance natural control of GM.**
FY 92 Research Attainments

Publications

Extramural

Elkinton, J.S.; Hajek, A.E.; Boettner, G.H.; Simons, E.E. 1991. Distribution and apparent spread of Entomophaga maimaiga (Zygomycetes: Entomophthorales) in gypsy moth (Lepidoptera: Lymantriidae) populations in North America. Environmental Entomology. 20 (6): 1601-1605.

Attainment

Approval was received from the USDA APHIS, PPQ to release an exotic species of microsporidia, Nosema sp. (near Serbicae), acquired from gypsy moth populations in Portugal, in three small woodlots in Central Michigan. The purpose of these releases is to measure the horizontal transmission of this pathogen among gypsy moth larvae and to hopefully establish microsporidia as a permanent biological control in U.S. gypsy moth populations. Preliminary dissections of field collected larvae indicate tht the initial rate of infection varied from 10-20% among early instar larvae, but very little horizontal transmission was achieved among late instar larvae. This is one aspect of a continuing program to introduce natural enemies of the gypsy moth from Europe and Asia in order to increase the incidence of natural control among our native gypsy moth populations.

Problem M1 **Develop and evaluate integrated pest management (IPM) strategies to manage the gypsy moth.**
FY 92 Research Attainments

Publications

Research Unit

McManus, Michael L. 1991. Gypsy moth, the superbug - can we contain its spread...and should we?. In: Entomology in Virginia: New problems and new approaches. 91-2. Blacksburg, VA: Virginia Agriculture Experiment Station, Virginia Polytechnic Institute and State University: 27-35.

Cooperative

Carter, M.R.; Ravlin, F.W.; McManus, M.L. 1991. Changes in gypsy moth (Lepidoptera: Lymantriidae) fecundity and male wing length resulting from defoliation. Environmental Entomology. 20 (4): 1042-1047.

Liebhold, Andrew M.; McManus, Michael L. 1991. Does larval dispersal cause the expansion of gypsy moth outbreaks?. Northern Journal of Applied Forestry. 8 (3): 95-98.

McFadden, Max W.; McManus, Michael L. 1991. An insect out of control? The potential for spread and establishment of the gypsy moth in new forest areas in the United States. In: Baranchikov Yuri N.; Mattson, William J.; Hain, Fred P.; Payne, Thomas L., eds. Proceedings of a joint IUFRO working party symposium for forest insect guilds 1989.; 1989 August 13-17; Abakan, Siberia, USSR. Gen. Tech. Rep. NE-153. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 172-186.

Extramural

Gray, D.R.; Logan, J.A.; Ravlin, R.W. 1991. Development of a predictive model of gypsy moth egg phenology. In: The gypsy moth in Virginia 1990. 444-030. Blacksburg, VA: Virginia Cooperative Extension Service: 142-143.

Gray, David R.; Logan, Jesse A.; Ravlin, F. William; Carlson, Jodi A. 1991. Toward a model of gypsy moth egg phenology: using respiration rates of individual eggs to determine temperature-time requirements of prediapause development. Environmental Entomology. 20 (6): 1645-1652.

Logan, J.A.; Casagrande, R.A.; Liebhold, A.M. 1991. Modeling environment for simulation of gypsy moth (Lepidoptera: Lymantriidae) larval phenology. Environmental Entomology. 20 (6): 1516-1525.

Ravlin, F.W.; Fleischer, S.J.; Carter, J.L. 1991. Development of a gypsy moth population monitoring system: sampling egg masses in IPM programs. In: The gypsy moth in Virginia 1990. 444-030. Blacksburg, VA: Virginia Cooperative Extension Service: 135-139.

Young, J.A.; Fleischer, S.J.; Ravlin, F.W.; Roberts, E.A.; Talley, S.; Macfarlane, R. 1991. Development of a county-based map display and analysis system for gypsy moth management. In: The gypsy moth in Virginia. 444-030. Blacksburg, VA: Virginia Cooperative Extension Service: 108-117.

Attainment

A modeling system was designed for assembling and implementing selected models that can be used to develop an effective tool needed to predict the larval phenology of the gypsy moth. A technique was also developed which uses a physiologically - based variable (CO2 evaluation) to distinguish different phases of egg phenology of the gypsy moth. These models are needed to describe gypsy moth development from egg through adult and to ultimately predict the expected occurence of life stages over a range of habitats. This information has practical application in sampling and or operational spray programs. It was recently demonstrated that levels of defoliation caused by gypsy moth larvae have an effect on both female fecundity and male moth wing length. This effect is essentially binomial and only is realized when defoliation exceeds a threshold level of ca. 40%. A simulation model was developed that describes the role of larval dispersal and bimodal density-dependent mortality in the spatial dynamics of gypsy moth densities. The model indicates that large scale expansion of outbreaks do not arise from foci, but probably develop synchronously over large areas and reflect patterns of resistant and susceptible stands.

Northeastern Forest Experiment Station
Forest Protection Research
Research Work Unit 4503

Impact of Atmospheric Deposition and Global Change on Forest Health and Productivity

Rebbeck, Joanne (Acting), Project Leader

FY 92 Research Attainments
Research Work Unit Summary

Problem number and title	Functional account	Current funding	Current staffing	Research Outputs		
				Research unit	Extra-mural	Cooper-ative
		thousand dollars	*scientist years*			
1. Effect of atmospheric deposition stress/change in global climate on tree growth and other	FPR	468	4.0	13	1	6
2. Deter. effects of atmos. dep. on mature trees and how effects differ from those found in seedlings	FPR	285	2.0	1		

Problem 1 **Effect of atmospheric deposition stress/change in global climate on tree growth and other**
FY 92 Research Attainments

Publications

Research Unit

Barger, Jack H.; Hall, Richard W.; Townsend, Alden M. 1992. Elm leaf beetle performance on ozone-fumigated elm. Res. Pap. NE-661. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 9 p.

Cannon, W.N., Jr.; Barger, J.H.; Hall, R.W. 1992. Growth response of gypsy moth larvae to CO2-fumigated white oak foliage. The Ohio Journal of Science. 92(2): 12. Abstract.

McQuattie, C.J. 1991. Influence of acidity and mycorrhizal status on the localization of lead in pine roots. In: Farmer, J.G., ed. Proceedings of the 8th international conference on heavy metals in the environment; 1991 September 16-20; Edinburgh, Scotland. Edinburgh, Scotland, UK: CEP Consultants, Ltd.: 107-110.

McQuattie, C.J.; Klomparens, K.L.; Wood, J.I. 1991. Comparison of chemical fixation and freeze substitution methods in the localization of lead in polyphosphate bodies of Pisolithus tinctorius. In: Farmer, J.G., ed. In: Proceedings of 8th international conference on heavy metals in the environment; 1991 September 16-20; Edinburgh, Scotland, UK. Edinburgh, Scotland, UK: CEP Consultants, Ltd.: 314-317.

McQuattie, C.J.; Klomparens, K.L.; Wood, J.I.; Heckman, J.W., Jr. 1992. Elemental distribution in trace metal-treated Pisolithus tinctorius prepared by propane jet and high pressure freezing methods. In: Bailey, G.W. [and others], eds. Proceedings of the 50th annual meeting of the Electron Microscopy Society of America; 1992 August 16-21; Boston, MA. San Francisco, CA: San Francisco Press, Inc.; 50: 730-731.

McQuattie, Carolyn J. 1992. Cytological effects of lead and zinc on mycorrhizal roots of Pinus rigida. The Ohio Journal of Science. 92(2): 15. Abstract.

Patton, Roy L.; Jensen, Keith F.; Schier, George A. 1991. Responses of red spruce seedlings to ozone acid deposition. Canadian Journal of Forest Research. 21: 1354-1359.

Rebbeck, Joanne; Loats, Ken. 1992. Does ozone preconditioning affect the response of hardwoods to ozone? The Ohio Journal of Science. 92(2): 16. Abstract.

Scherzer, Amy J.; Boerner, Ralph E.J. 1992. Effects of ozone on carbon allocation in sugar maple (Acer saccharum). The Ohio Journal of Science. 92(2): 15. Abstract.

Scherzer, Amy J.; Boerner, Ralph E.J. 1992. Ozone effects on short-term carbon allocation in sugar maple (Acer saccharum). Bulletin of the Ecological Society of America 73(2) (Suppl.): 336. Abstract.

Schier, G.A.; McQuattie, C.J. 1991. Aluminum toxicity in white pine seedlings and the modulating effects of a mycorrhizal symbiont. In: Abstracts and papers: air pollution, climate change, and biodiversity; 1991 May 20-23; Mackinaw Island, MI. Misc. Publ. 91-10. Abstract. Houghton, MI: Michigan Technological University: 33.

Schier, George A.; Jensen, Keith F. 1992. Atmospheric deposition effects on foliar injury and foliar leaching in red spruce. In: Eagar, Christopher; Adams, Mary Beth, comps., eds. Ecology and decline of red spruce in the Eastern United States. Ecological Studies 96. New York, NY: Springer-Verlag: 271-294.

Schier, George A.; McQuattie, Carolyn J.; Jensen, Keith F. 1990. Effect of ozone and aluminum on pitch pine (Pinus rigida) seedlings: growth and nutrient relations. Canadian Journal of Forest Research. 20 (11): 1714-1719.

Cooperative

Adams, Mary Beth; Nichols, Dale S.; Federer, C. Anthony; Jensen, Keith F.; Parrott, Harry. 1991. Screening procedure to evaluate effects of air pollution on eastern region wildernesses cited as class 1 air quality areas. Gen. Tech. Rep. NE-151. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 33 p.

Dubois, Normand R.; Barger, Jack H. 1991. Effects of simulated acid rain on Bacillus thuringiensis residual against gypsy moth, New Haven County, Connecticut, 1990. Insecticide and Acaricide Tests. 16: 273-274.

Krause, C.R.; Cannon, W.N., Jr. 1991. Epistomatal wax injury to red spruce needles (Pices rubens Sarg.) grown in elevated levels of ozone and acidified rain. Scanning Microscopy. 5 (4): 1173-1180.

Noble, Reginald; Jensen, Keith F.; Ruff, Bradley S.; Loats, Ken. 1992. Response of Acer saccharum seedlings to elevated carbon dioxide and ozone. The Ohio Journal of Science. 92 (3): 60-62.

Roberts, Bruce R.; Cannon, Williams N., Jr. 1992. Growth and water relationships of red spruce seedlings exposed to atmospheric deposition and drought. Canadian Journal of Forest Research. 22 (2): 193-197.

Stephenson, Steven L.; McQuattie, Carolyn J.; Edwards, Pamela J.; Studlar, Susan M. 1992. The effect of stream pH on the distribution, ecology, and ultrastructure of Scapania nemorea. Proceedings of the West Virginia Academy of Science. 64(1): 18. Abstract.

Extramural

Scherzer, Amy Jo. 1991. Effects of ozone and/or nitrate deposition on the growth and ecophysiology of sugar maple (Acer saccharum). Columbus, OH: The Ohio State University. 176 p. Ph.D. dissertation.

(Forest Service provided the use of the fumigation facilities and Li-Cor photosynthetic system as well as general plant care for this research)

Attainment

Research was conducted to determine how atmospheric deposition affects tree growth. The interaction of these pollutants with global change parameters, (i.e. elevated CO2) and with biotic stresses (i.e. insect feeding) was also investigated. Exposures to ozone (O3) alone had no significant effect on red spruce growth an increase in precipitation acidity affected only terminal length. It was concluded that red spruce seedlings that receive ample nutrient and water are tolerant to O3 and changes in precipitation acidity. In a drought-O3-acid precipitation study, O3 alone (0.25ppm) or acid precipitation (pH 3.0) alone caused the greatest reduction in growth. However, acid precipitation (pH 4.2) + O3 had the least effect on growth, suggesting that these pollutants may have acted antagonistically. Newly germinated sugar maple seedlings exposed to elevated CO2 tended to exhibit increases in photosynthesis and biomass. Ozone alone had no effect, but with O3 + elevated CO2, an increase in biomass was observed. Carbon 14 labeling experiments demonstrated no O3 effects on the short-term allocation of carbon, but decreases in root biomass were observed when compared to charcoal-filtered (CF) grown sugar maples. In insect-pollutant interaction studies, third instar gypsy moth larvae showed an increased efficiency in the food conversion into body mass when fed white oak foliage exposed to 700 ppm CO2 compared to those fed ambient-grown foliage. Female elm leaf beetles (ELB) fed O3-fumigated elm foliage laid significantly fewer eggs than females fed CF foliage. These studies demonstrate that pollutants such as O3 and elevated CO2 can influence insect behavior.

Problem 2 **Deter. effects of atmos. dep. on mature trees and how effects differ from those found in seedlings**
FY 92 Research Attainments

Publications

Research Unit

Rebbeck, Joanne; Jensen, Keith F.; Greenwood, Michael S. 1992. Ozone effects on the growth of grafted mature and juvenile red spruce. Canadian Journal of Forest Research. 22 (5): 756-760.

Attainment

To understand the effect of anthrogenic stress on forest ecosystems, the influence of these stresses on plants of all ages and stages of development must be understood. Problems are encountered in the extrapolation of data from seedlings to mature trees because there are distinct physiological and morphological differences. Studies are currently underway which address the differences in the response of seedlings and mature trees to atmospheric deposition. Approaches include: ozone exposure of mature tissue grafted onto seedlings; development of a branch chamber exposure system for hardwood species; the physiological morphological, and chemical characterization of seedlings, saplings, and mature trees grown in natural forest ecosystems; and the long-term fumigation to ozone and CO2 of hardwood and conifer seedlings as they mature. After 18 weeks of exposure to ozone as high as 170 ppb, grafted seedling and mature scions of red spruce did not differ in their responses to ozone, despite differences in growth and biomass production. This suggests that tissue age may not be a factor in ozone-tolerant species such as red spruce but does not preclude it from being critical for other species which may be more ozone sensitive.

Northeastern Forest Experiment Station
Forest Protection Research
Research Work Unit 4505

Etiology, Epidemiology and Physiology of Stress-Regulated Host-Pest Interactions (Stress-Triggered Tree Diseases)

Wargo, Philip M., Project Leader

FY 92 Research Attainments
Research Work Unit Summary

Problem number and title	Functional account	Current funding	Current staffing	Research Outputs: Research unit	Research Outputs: Extra-mural	Research Outputs: Cooperative
		thousand dollars	*scientist years*			
1. Role of disease-causing organisms in stress initiated dieback and decline diseases	FPR	450	.7	3		
2. Genetic makeup and pathogenic capabilities of pest populations damaging stressed trees	FPR	102	.3	2		
3. Better understanding of how forest management practices influence decline diseases	FPR	125	1.0			

Problem 1 **Role of disease-causing organisms in stress initiated dieback and decline diseases**
FY 92 Research Attainments

Publications

Research Unit

Houston, David R. 1992. Importance of buttress root and taphole wounds as infection courts for the sugar maple (Acer saccharum) sapstreak pathogen, Ceratocystis coerulescens. Phytopathology 82:244. Abstract.

Wargo, Philip M.; Kile, Glen A. 1992. Armillaria root disease. In: Mukhopadhyay, A.N.; Kumar, J.; Singh, U.S.; Chaube, H.S., comps., eds. Plant diseases of international importance: Volume 4: diseases of sugar, forest, and plantation crops. Englewood Cliffs, NY: Prentice Hall: 311-345.

(I was asked to prepare the chapter and I invited Dr. Kile, CSIRO, Australia to join me as coauthor.)

Wargo, Philip M. 1992. Multiple factors in oak decline in the United States. In: Book of Abstracts. Recent advances in studies on oak decline conference; 1992 September 13-18; Brindisi, Italy. Abstract.

Attainment

Beech bark disease: Preliminary examination of long-run data acquired in disease monitoring plots from Maine to West Virginia suggest that trends in beech scale and Nectria fungus populations differ regionally and may reflect the influence of regional climate variables. Red spruce decline: Studies on the relationship of winter injury and red spruce decline were completed. This is the first report that documents the effects of winter injury on radial and apical growth of mature trees. Both healthy and declining trees showed needle loss from winter injury, however, the effects of winter injury on radial and terminal growth reduction was greater on declining trees. Effects of winter injury on radial growth appear in the growing season immediately after the event; effects on apical growth seem to occur in the third growing season after the event. Results will be published in Canadian Journal of Forestry in 1993. Results presented as a poster at regional SAF meeting in autumn 1991.

Problem 2 **Genetic makeup and pathogenic capabilities of pest populations damaging stressed trees**
FY 92 Research Attainments

Publications

Research Unit

Houston, David R. 1991. Changes in tree pathogen populations–a consideration for the arborist?. Tree Times Quarterly. 2 (3): 1-2.

Mahoney, Eileen M. 1991. Molecular genetic relationships of Nectria coccinea var. faginata, a pathogen of American beech, to European and North American nectrias. Phytopathology 81:1142. Abstract.

Attainment

Armillaria: Studies on Armillaria in mixed oak stands show that plots with less mortality have fewer and larger clones than those with greater mortality. Armillaria species are similar. Clones are not mutually exclusive and up to three different genotypes can occur on some trees. A gallica is the dominant species present in these stands. Molecular genetic analyses of isolates will verify information derived from culture techniques. Beech bark disease: Repeated isolations since 1982 from diseased beech trees in Monongahela Nat'l. Forest reveal that in many stands the originally dominant native bark pathogen, Nectria galligena (NG), is being replaced by Nectria coccinea var. faginata (Ncf), a fungus possibly introduced to the Northeast from Europe in the late 1800's. Isolations from diseased trees in PA, NY, and elsewhere, suggest that similar shifts in pathogen populations may have occurred in these earlier-affected forests. Molecular genetics data show that Ncf is genetically uniform throughout its range in North America and is more genetically similar to N. coccinea var. coccinea (the European pathogen) than it is to native North American isolates of N. coccinea. These data additionally support the hypothesis that Ncf may have been introduced into North America. An abstract for a portion of this work will be presented at the regional APS meetings in Nov. 1992 and all results will be published as a doctoral thesis at Cornell University by Dec. 1992.

Problem 3 **Better understanding of how forest management practices influence decline diseases**
FY 92 Research Attainments

Publications

none

Attainment

Beech bark disease (BBD): A major trial to silviculturally manage BBD by regulating root sprouting in resistant and susceptible beech trees compared root sprouting on (1) standing trees vs. cut trees, (2) disease resistant, high vigor trees vs. susceptible, disease-debilitated trees, (3) clear-cut vs. partial cut and (4) winter cut vs. summer cut. The first year's data indicates that more sprouting occurs on roots of stumps than of trees; on vigorous trees than on debilitated trees; and on trees cut in the summer than in the winter. Management of sugarbushes–taphole pathology: The effects of paraformaldehyde (PF) tablets placed in tapholes (TH's) to increase sap yields observed in 16 sugarbushes in WI, showed no relationship between PF use and the number of TH's that were open, oozing, or had cambial dieback, but the amount of cambial dieback was significantly correlated with crown condition. Information was presented at several local and national maple syrup meetings and scientific mtgs. Armillaria: Abundance of rhizomorphs on crop trees was not related to abundance of rhizomorphs in the soil, number of dead trees or stumps in the plots with rhizomorphs, or total number of potential substrates in the plots. Data suggest that the fungus' status on the roots of crop trees may operate independent of the level in the soil or on nearby substrates. These results will be used to prepare rules of thumb for foresters making decisions about mortality after defoliation from Armillaria root disease.

Northeastern Forest Experiment Station
Forest Protection Research
Research Work Unit 4507

Silvicultural Options for the Gypsy Moth
Gottschalk, Kurt W., Project Leader

FY 92 Research Attainments
Research Work Unit Summary

Problem number and title	Functional account	Current funding	Current staffing	Research Outputs		
				Research unit	Extra-mural	Cooper-ative
		thousand dollars	*scientist years*			
1. Effects of damage by the gypsy moth and its associated organisms in various type of stands	FPR	235	.6	3	2	1
2. Silviculture practices in reducing damage to forest stands by the gypsy moth	FPR	175	.8	2	2	2
3. Develop and evaluate decision-making systems to manage the gypsy moth	FPR	512	2.4	9	4	3
4. Northeast Decision Model Development	FPR	348	1.2	1		
5. Global Change Program	FPR	15	.5			
6. Miscellaneous topics	FPR	0	.2	2		1

Problem 1 **Effects of damage by the gypsy moth and its associated organisms in various type of stands**
FY 92 Research Attainments

Publications

Research Unit

Twery, Mark J. 1992. New tools for hazard rating: GIS and the gypsy moth. In: Proceedings: North American Forest Insect Work Conference, 1991 March 25-28; Denver, CO. Gen. Tech. Rep. PNW-GTR-294. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 69-70. Abstract.

Twery, Mark J.; Feicht, David L.; Fosbroke, Sandra L.C. 1992. Understory development following thinning and defoliation in West Virginia. Bulletin of the Ecological Society of America. 73(2) (Suppl.): 370. Abstract.

Twery, Mark J.; Feicht, David L.; Fosbroke, Sandra L.C. 1992. Understory development following thinning and defoliation in West Virginia. In: Gjerstad, Dean H.; Glover, Glenn R., comps. International conference on forest vegetation management: ecology, practice and policy: program and abstracts; 1992 April 27-May 1; Auburn, AL. Sch. For. Rep. 1992:1. Auburn, AL: Auburn University: 132. Abstract.

Cooperative

Lynch, Ann M.; Twery, Mark J. 1992. Forest visual resources and pest management: potential applications of visualization technology. Landscape and Urban Planning. 21 (4): 319-321.

Extramural

Hicks, Ray R., Jr. 1992. The hazards of hazard rating. In: Proceedings: North American Forest Insect Work Conference; 1991 March 25-28; Denver, CO. Gen. Tech. Rep. PNW-GTR-294. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 182. Abstract.

Hollenhorst, Steve; Brock, Sam. 1991. Aesthetics, forestry, and the gypsy moth. In: 1991 annual report. Morgantown, WV: West Virginia University; Agriculture and Forest Experiment Station: 36-37.

Attainment

Research continues on the effects of gypsy moth defoliation on forest resources. Presentations and papers were presented on this subject to a variety of audiences, including other research scientists, gypsy moth managers, extension agents, landowners, and the general public. Traditionally, research on gypsy moth impacts has focused on direct impacts of gypsy moth defoliation on forest growth and yield. Research underway concentrates on this subject but also on other forest resources such as wildlife, biotic diversity, scenic beauty, and water quality. In 1992 an important study of impacts of gypsy moth - induced tree mortality on scenic beauty was published. This study yielded surprising and important results: low levels of tree mortality may have little or no effect on scenic beauty - negative impacts were only apparent in scenes with high levels of mortality. Furthermore, informed and uninformed viewers did not substantially differ in the way tree mortality affected their perception of scenic beauty. These results will be useful for managers that are considering gypsy moth suppression in order to protect visual resources and for social scientists that are involved in public education on the gypsy moth problem.

Problem 2 **Silviculture practices in reducing damage to forest stands by the gypsy moth**
FY 92 Research Attainments

Publications

Research Unit

Gottschalk, Kurt W. 1992. Herbivory and harvesting effects on development of interfering vegetation in Quercus stands. Bulletin of the Ecological Society of America. 73(2) (Suppl.): 190. Abstract.

Gottschalk, Kurt W. 1992. Herbivory and harvesting effects on development of interfering vegetation in Quercus stands. In: Gjerstad, Dean H.; Glover, Glen R., comps. International conference on forest vegetation management: ecology, practice and policy: program and abstracts; 1992 April 27-May 1; Auburn, AL: Sch. For. Rep. 1992:1. Auburn, AL: Auburn University: 86. Abstract.

Cooperative

Hicks, Ray R., Jr.; Fultineer, Robert M.; Ware, Barbara S.; Gottschalk, Kurt W. 1991. Gypsy moth defoliation in clearcuts. In: 1991 annual report. Morgantown, WV: West Virginia University; Agriculture and Forest Experiment Station: 38-40.

Hicks, Ray R., Jr.; Fultineer, Robert M.; Ware, Barbara S.; Gottschalk, Kurt W. 1991. Susceptibility and vulnerability of young oak regeneration in clearcuts to defoliation by gypsy moth. In: Proceedings of the national gypsy moth review; 1991 November 4-7; Raleigh, NC. [Place of publ. unknown]: National Gypsy Moth Management Board: 80-92.

Extramural

Butler, Linda; Kondo, Vicki. 1991. Macrolepidopterous moths collected by blacklight trap at Cooper's Rock State Forest, West Virginia: A baseline study. Bull. 705. Morgantown, WV: West Virginia University. 25 p.

Wood, Peter S.; Butler, Linda. 1991. Biology of Morrisonia confusa (Noctuidae). Journal of the Lepidopterists' Society. 45 (3): 197-203.

Attainment

The development and technology transfer of Silvicultural guidelines to minimizing the impacts of gypsy moth defoliation has continued with the collection of data at demonstration research areas and presentation of guidelines to users of numerous meetings. Results from a study that examined the interaction of various harvesting systems, deer browsing, and gypsy moth defoliation indicated that both hunting and defoliation resulted in increased competition to regeneration by harbaceous vegetation (Probably due to changes in nitrogen levels and light levels) and deer browsing substantially affected the gypsy moth defoliation effects in clearcuts indicated that oak seedlings in clearcuts suffer defoliation levels comparable with oaks in surrounding stands and that clearcut size and age has little effect on defoliation levels.

Problem 3 **Develop and evaluate decision-making systems to manage the gypsy moth**
FY 92 Research Attainments

Publications

Research Unit

Colbert, J.J. 1992. Effects of the gypsy moth life system on growth and yield of mixed hardwood stands. In: Teller, A.; Mathy, P.; Jeffers, J.N.R., eds. Responses of forest ecosystems to environmental changes; 1991 May 20-24; Florence, Italy. New York, NY: Elsevier Applied Science: 961-962.

Liebhold, A.M.; Elkinton, J.S. 1991. Gypsy moth dynamics. Trends in Ecology and Evolution. 6(8): 263-264. Letter to the Editor.

Liebhold, Andrew. 1992. New approaches to sampling for decision making. Gypsy Moth News. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Area State and Private Forestry: 10-13.

Liebhold, Andrew M. 1992. Are North American populations of gypsy moth (Lepidoptera: Lymantriidae) bimodal?. Environmental Entomology. 21 (2): 221-229.

Liebhold, Andrew M.; Luzader, Eugene; Elmes, Gregory. 1991. Gypsy moth spread in the past and future. In: Proceedings of the national gypsy moth review; 1991 November 4-7; Raleigh, NC. [Place of publ. unknown]: National Gypsy Moth Management Board: 74-79.

Liebhold, Andrew M.; Twardus, Daniel; Buonaccorsi, John. 1991. Evaluation of the timed-walk method of estimating gypsy moth (Lepidoptera: Lymantriidae) egg mass densities. Journal of Economical Entomology. 84 (6): 1774-1781.

Liebhold, Andrew M.; Zhang, Xu; Hohn, Michael E.; Elkinton, Joseph S.; Ticehurst, Mark; Benzon, Gary L. 1991. Geostatistical analysis of gypsy moth (Lepidoptera: Lymantriidae) egg mass populations. Environmental Entomology. 20 (5): 1407-1417.

Racin, G.E.; Colbert, J.J. 1992. Interface management system for the stand-damage model. In: Watson, Dennis G.; Zazueta, Fedro S.; Battcher, A.B., eds. Computers in Agricultural Extension programs: Proceedings of the 4th international conference; 1992 January 28-31; Orlando, FL. ASAE Publ. 1-92. St. Joseph, MI: American Society of Agricultural Engineers: 411-416.

Sheehan, Katherine A. 1992. User's guide for GMPHEN: a gypsy moth phenology model. Gen. Tech. Rep. NE-158. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 29.

Cooperative

Elmes, Gregory A.; Fugikawa, Edward K.; Twery, Mark J. 1992. Comparison of slope position models in vector and raster GIS species composition estimation. In: ASPRS/ACSM/RT 92: Technical papers. Volume 3: GIS and cartography; 1991 August 2-8; Washington, DC. Bethesda, MD: American Society for Photogrammetry and Remote Sensing and American Congress on Surveying and Mapping: 421-427.

Logan, J.A.; Casagrande, R.A.; Liebhold, A.M. 1991. Modeling environment for simulation of gypsy moth (Lepidoptera: Lymantriidae) larval phenology. Environmental Entomology. 20 (6): 1516-1525.

Lyons, D. Barry; Liebhold, Andrew M. 1992. Spatial distribution and hatch times of egg masses of gypsy moth (Lepidoptera: Lymantriidae). Environmental Entomology. 21 (2): 354-358.

Extramural

Cai, Guoray; Elmes, Gregory A. 1992. Towards intelligent databases for geographical information systems. In: ASPRS/ACSM/RT 92: Technical papers. Volume 3: GIS and cartography; 1992 August 2-8; Washington, DC. Bethesda, MD: American Society for Photogrammetry and Remote Sensing and American Congress on Surveying and Mapping: 388-397.

Logan, J.A.; Allen, J.C. 1992. Nonlinear dynamics and chaos in insect populations. Annual Review of Entomology. 37: 455-477.

Logan, Jesse A.; Hain, Fred P., eds. 1991. Chaos and insect ecology; 1990 August 5-11; Montreal, PQ. Inf. Ser. 91-3. Blacksburg, VA: Virginia Agricultural Experiment Station, Virginia Polytechnic Institute and State University. 108 p.

Schaub, L.P.; Ravlin, F.W.; Logan, J.A. 1991. Monitoring system designer, defoliation predictor, and phenology predictor components of GypsES. In: The gypsy moth in Virginia. 444-030. Blacksburg, VA: Virginia Cooperative Extension Service: 144-146.

Attainment

Design has been completed for Version 1 of GypsES, a decision support system to provide hazard rating, insect monitoring, defoliation predictions, and interaction recommendations for gypsy moth managers. The system is being developed to run under the X-Windows graphical user interface and integrates portions of the GRASS geographical information system for spatial manipulations. A preliminary version is being tested in the field by county level and district-level personnel. A geostatistical modeling technique has been adopted of a method for forecasting future defoliation levels from historical maps of defoliation. This method models historical spatial and temporal dependence in defoliation to predict the future distribution of defoliation. Version 1 of the stand-damage component of the Gypsy Moth Life System Model has been released to interested parties. The model features a user "friendly" front-end that allows users with little computer skills to easily vary initial stand and environmental conditions in order to evaluate the effects of gypsy moth defoliation or forest growth and yield.

Problem 4 **Northeast Decision Model Development**
FY 92 Research Attainments

Publications

Research Unit

Twery, Mark J. 1992. The Northeast decision model. In: Proceedings, 20th annual hardwood symposium of the hardwood research council; 1992 June 1-3; Cashiers, NC. Memphis, TN: Hardwood Research Council: 127-130.

Attainment

A beta-test version of the Northeast Decision Model simulator submodel is currently running on DOS machines using codes developed in both Fortran and C. Growth simulations, stand-inventory summaries, volume and value routines, and cutting prescriptions are fully functional. The incorporation of user-specified management goals, including a stand alone module to identify and resolve conflicts, is in progress. The integration of the GIS capabilities necessary for full functionality of the wildlife and other modules is in its early stages.

Problem 5 **Global Change Program**
FY 92 Research Attainments

Publications

none

Attainment

No progress to report this period.

Problem 6 **Miscellaneous topics**
FY 92 Research Attainments

Publications

Research Unit

Jennings, Daniel T.; Crawford, Hewlette S., Jr.; Hunter, Malcolm L., Jr. 1991. Predation by amphibians and small mammals on the spruce budworm (Lepidoptera: Tortricidae). The Great Lakes Entomologist. 24 (2): 69-74.

Liebhold, Andrew M.; Silk, Peter J. 1991. Capture of Choristoneura pinus maritima in traps baited with C. pinus pheromone components (Tortricidae). Journal of the Lepidopterists' Society. 45 (2): 172-173.

Cooperative

Welbourn, W. Calvin; Jennings, Daniel T. 1991. Two new species of Erythraeidae (Acari: Prostigmata) associated with the spruce budworm, (Choristoneura fumigerana (Clemens) (Lepidoptera: Tortricidae) in Maine. The Canadian Entomologist. 123: 567-580.

Attainment

This problem covers miscellaneous research by RWU Scientists that is not related to gypsy moth, the NE Decision Model, or Global Change. In 1992, general papers under this problem were published on spruce budworm predators and pheromone attraction of the Jack Pine budworm.

Northeastern Forest Experiment Station
Forest Protection Research
Research Work Unit 4509

Applications of Biotechnology in Forest Pest Management
Slavicek, James M., Project Leader

FY 92 Research Attainments
Research Work Unit Summary

Problem number and title	Functional account	Current funding	Current staffing	Research Outputs		
				Research unit	Extra-mural	Cooper-ative
		thousand dollars	*scientist years*			
1. Understand the genomic structure, gene function, and pathogenic mechanism of gypsy moth NPVs.	FPR	894	6.0	14	1	
2. Develop bacillus subtilis as a biological control agent of vascular wilt pathogens	FPR	255	1.0			1

Problem 1 **Understand the genomic structure, gene function, and pathogenic mechanism of gypsy moth NPVs.**
FY 92 Research Attainments

Publications

Research Unit

Hiremath, Shivanand; Jones, Davy. 1992. Juvenile hormone regulation of vitellogenin in the gypsy moth, Lymantria dispar: suppression of vitellogenin mRNA in the fat body. Journal of Insect Physiology. 38 (6): 461-474.

Hiremath, Shivanand T.; Slavicek, James M. 1992. Recombinant LdNPV expressing bacterial beta-galactosidase. In: Proceedings, U.S. Department of Agriculture interagency gypsy moth research forum 1991; 1991 January 14-17; Annapolis MD. Gen. Tech. Rep. NE-167. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 38-39. Abstract.

Hiremath, Shivanand. 1992. Purification, characterization and regulation by juvenile hormone of vitellogenin in the gypsy moth. In: Proceedings, U.S. Department of Agriculture interagency gypsy moth research forum 1991; 1991 January 14-17; Annapolis, MD. Gen. Tech. Rep. NE-167. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 37-38. Abstract.

Slavicek, James. 1991. Genetically engineered organisms: recent applications of recombinant DNA technology to agents of microbial control. In: Proceedings of the 23rd annual Northeastern Forest Insect Work Conference; 1990 March 8-9; Albany, NY. Syracuse, NY: College of Environmental Science & Forestry, State University of New York: 14-16.

Slavicek, James M. 1992. A functional gene map of the Lymantria dispar nuclear polyhedrosis virus (LdNPV): the organization of the LdNPV genome is not colinear to that of the Autographa californica nuclear polyhedrosis virus (AcNPV). In: Proceedings, U.S. Department of Agriculture interagency gypsy moth research forum 1991; 1991 January 14-17; Annapolis, MD. Gen. Tech. Rep. NE-167. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 46-47. Absract.

Slavicek, James M.; Podgwaite, John. 1992. Analysis of Lymantria dispar nuclear polyhedrosis viruses (LdNPV) isolated from Gypchek: purification of high potency LdNPV isolates. In: Proceedings, U.S. Department of Agriculture interagency gypsy moth research forum 1991; 1991 January 14-17; Annapolis, MD. Gen. Tech. Rep. NE-167. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 47-48. Abstract.

Slavicek, James M. 1991. Enhancement of Lymantria dispar nuclear polyhedrosis virus efficacy, potency, and polyhedra production in cell culture through biotechnology. In: Proceedings of the national gypsy moth review; 1991 November 4-7; Raleigh, NC. [Place of publ. unknown]: [Publisher name unknown]: 68-73.

Slavicek, James M. 1991. Enhancement of biological control agents for use against forest insect pests and diseases through biotechnology. In: Technology 2001: the 2nd national technology transfer conference and exposition; 1991 December 3-5; San Jose, CA. NASA Conf. Publ. 3136. New York, NY: The Technology Utilization Foundation: 51-58. Vol. 1.

Slavicek, James M. 1991. Temporal analysis and spatial mapping of Lymantria dispar nuclear polyhedrosis virus transcripts and in vitro translation polypeptides. Virus Research. 20: 223-236.

Slavicek, James M. 1992. Baculoviruses: production strategies and prospects for genetic engineering. In: Allen, Douglas C.; Abrahamson, Lawrence P., eds. Proceedings; North American Forest Insect Work Conference; 1991 March 25-28; Denver, CO. Gen. Tech. Rep. PNW-GTR-294. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station: 102-103.

(PNW-GTR-294, February 1992)

Slavicek, James M.; Podgwaite, John; Lanner-Herrera, Carita. 1992. Properties of two Lymantria dispar nuclear polyhedrosis virus isolates obtained from the microbial pesticide Gypchek. Journal of Invertebrate Pathology. 59: 142-148.

Valaitis, Algimantas P. 1992. Purification and properties of three regulatory enzymes from the gypsy moth. In: Proceedings, U.S. Department of Agriculture interagency gypsy moth research forum 1991; 1991 January 14-17; Annapolis, MD. Gen. Tech. Rep. NE-167. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 51-52. Abstract.

Valaitis, Algimantas P. 1991. Characterization of hemolymph juvenile hormone esterase from Lymantria dispar. Insect Biochemistry. 21 (6): 583-595.

Valaitis, Algimantas P.; Kemp, Robert G. 1992. Molecular characterization of 6-phosphofructo-1-kinase purified from Lymantria dispar. Insect Biochemistry and Molecular Biology. 22 (5): 481-489.

Extramural

Yocum, George D.; Joplin, Karl H.; Denlinger, David L. 1991. Expression of heat shock proteins in response to high and low temperature extremes in diapausing pharate larvae of the gypsy moth, Lymantria dispar. Archives of Insect Biochemistry and Physiology. 18 (4): 1-11.

(Article no. 457)

Attainment

Gypsy moth research: Juvenile hormone esterase was purified from Lymantria dispar and characterized through analysis of enzymatic activity, amino acid composition and partial amino acid sequencing. The results of this study provides basic knowledge on an enzyme that participates in the regulation of juvenile hormone. Hormonal regulation of vitellogenin synthesis and accumulation in Lymantria dispar was investigated using a juvenile hormone analog. Vitellogenin gene expression was found to be regulated by juvenile hormone. Further study on the regulation of gene expression by juvenile hormone may lead to development of novel biorational insect control agents. Gypsy moth virus research: A transcription and translation map of the Lymantria dispar nuclear polyhedrosis virus (LdNPV) was generated. These results provide basic knowledge on viral gene organization and expression that is prerequisite for further studies on the function of specific LdNPV genes. A LdNPV few polyhedra (FP) plaque mutant was isolated and characterized. FP mutant formation occurs at high frequency during viral replication in vitro, and consequently is an impediment to LdNPV production in vitro. Study of FP mutants will facilitate development of viral strains refractory to FP mutant formation. The results of the studies described above have been disseminated through publication of papers and abstracts in journals and proceedings. In preparation for the field testing of a genetically engineered LdNPV, UMASS cooperators have tracked the spread of LdNPV under field conditions to provide necessary knowledge for development of the field test protocol. Cooperating scientist at the Boyce Thompson Institute have developed techniques for the co-occlusion of wild type and engineered strains of LdNPV which will be used to generate co-occluded virus for the field test.

Problem 2 **Develop bacillus subtilis as a biological control agent of vascular wilt pathogens**
FY 92 Research Attainments

Publications

Cooperative

Domir, Subhash C.; Schreiber, Lawrence R.; Ichida, Jann M.; Eshita, Steven M. 1992. Effect of elm selection, explant source and medium composition on growth of Ophiostoma ulmi on callus cultures. Journal of Environmental Horticulture. 10 (1): 59-62.

Attainment

A bacteria was isolated from the vascular system of an American elm that exhibited antifungal activity against Ophiostoma ulmi and Cryphonectria parasitica (phytopathogens that cause Dutch elm disease and chestnut blight, respectively). The bacteria was identified as Pseudomonas gladioli. Studies were initiated to assess efficacy of the bacteria against Cryphonectria parasitica in American chestnut trees and Ophiostoma ulmi in American elm trees.

Northeastern Forest Experiment Station
Forest Protection Research
Research Work Unit 4510

Tree Response to Injury and Infection in a Changing Environment

Shortle, Walter C., Project Leader

FY 92 Research Attainments
Research Work Unit Summary

Problem number and title	Functional account	Current funding	Current staffing	Research Outputs		
				Research unit	Extra-mural	Cooper-ative
		thousand dollars	*scientist years*			
1. Determine magnitude of forest damage attributable to nutrient deficiencies re acid deposition	FPR	80	2.0	1		1
2. Develop dependable early markers for detecting changes in vulnerability of forest trees to	FPR	40	1.0	3		2

Problem 1 **Determine magnitude of forest damage attributable to nutrient deficiencies re acid deposition**
FY 92 Research Attainments

Publications

Research Unit

Shortle, Walter C.; Bondietti, Ernest A. 1992. Timing, magnitude, and impact of acidic deposition on sensitive forest sites. Water, Air, and Soil Pollution. 1992; 61: 253-267.

Cooperative

Jellison, J.; Smith, Kevin C. [T.]; Shortle, Walter T. [C.]. 1992. Cation analysis of wood degraded by white- and brown-rot fungi. The International Research Group on Wood Preserv. Document:IRG/WP/1552-92. Stockholm, Sweden: IRG Secretariat. 16 p.

(IRG = International Research Group and the published series is International Research Group on Wood Preservation.)

Attainment

Preliminary research on the timing, magnitude, and impact of acid deposition on sensitive forest sites, which have thick humus layers in which cation exchange is highly sensitive to acid input, was published. Estimated concentrations of essential cations (Ca2+ and Mg2+) in the root-humus complex of well-developed forest mor appeared to fit the generalized concept of equilibrium in eastern North America before 1950 and in remote areas from 1940 to 1975, but not in eastern North America after 1970. Between 1950 and 1970 in eastern North America atmospheric acidity increased and rates of tree growth peaked in sensitive forest sites. The apparent lack of fit is consistent with the theory of mobilization and sensitivity to increasing acidity which caused a shift in the equilibrium of the root-humus complex on sensitive sites and produced a cation mobilization signal in wood was found to be coincident to the period of lake acidification at one site. Resampling another site with detailed analysis of essential exchangeable cations indicated a loss of 75% of these cations from rooting zone between 1929 and 1989 with a cation mobilization in wood dated to the 1950-1970 period. These results help support the postulated effect of acidic deposition on sensitive forest sites and from the basis for newly initiated research on the adverse effects of acidic deposition on forest fertility and tree health. Another aspect to be studied is the release of essential cations from dead and decaying trees to the forest floor by decay fungi. Mobilization of cations by fungi at high mortality sites may account for partial restoration of essential exchangeable cations in the root-humus complex of the forest floor.

Problem 2 **Develop dependable early markers for detecting changes in vulnerability of forest trees to**
FY 92 Research Attainments

Publications

Research Unit

Minocha, R.; Minocha, S.C.; Komamine, A.; Shortle, W.C. 1991. Regulation of DNA synthesis and cell division by polyamines in Catharanthus roseus suspension cultures. Plant Cell Reports. 10: 126-130.

Smith, Kevin T. 1992. The art of tree pruning. Arbor Age. 12 (3): 42.

Smith, Kevin T.; Shortle, Walter C. 1992. Decay fungi increase the moisture content of dried wood. In: Rossmoore, H.W., comp., ed. Biodeterioration and Biodegradation 8. New York, NY: Elsevier Science Publishers: 138-146.

Cooperative

Minocha, Subhash C.; Minocha, Rakesh; Komamine, Atsushi. 1991. Effects of polyamine biosysthesis inhibitors on S-adenosylmethionine synthetase and S-adenosylmethionine decarboxylase activities in carrot cell cultures. Plant Physiology and Biochemistry. 29 (3): 237-237.

Ranson, K.J.; Rock, B.N.; Salas, W.A.; Smith, K.; Williams, D.L. 1992. Analysis of the dielectric properties of trunk wood in dominant conifer species from New England and Siberia. In: Proceedings of the International Geophysical and Remote Sensing Symposium; 1992 May 11-14; Clearwater, TX. Washington, DC: Institute of Electrical and Electronics Engineers: 1283-1285.

Attainment

Changes in forest floor chemistry related to atmospheric changes will put forests at risk from a variety of abiotic and biotic stressors. Finding useful markers for detecting early responses of mature trees, as they become more vulnerable to stress, will help in understanding adverse effects of environmental changes on trees of the forest canopy. Changes in the water and ions of tree tissues are potentially useful markers that can be detected by rapid, simple electrical techniques. Changes in microbial populations readily observed in culture is another possibility. Changes in cellular biochemical systems which regulate DNA synthesis and cell division are another possibility. initial steps with model systems are being undertaken in the beginning stages of research on early markers of vulverability in trees. Work on detection, diagnosis, and remediation of vulverability in trees by such practices as pruning, fertilization, and other manipulations which influence basic tree biology will be conducted to help improve tree health in our forests, woodlots, and homesites.

Northeastern Forest Experiment Station
Forest Products and Harvesting Research
Research Work Unit 4701

Improved Processing Technology for Hardwoods
Brisbin, Robert L., Project Leader

FY 92 Research Attainments
Research Work Unit Summary

Problem number and title	Functional account	Current funding	Current staffing	Research Outputs		
				Research unit	Extra-mural	Cooper-ative
		thousand dollars	*scientist years*			
1. Need to develop techniques to evaluate production /economic implications using new processing	FPHR	558	2.5	5	1	1
2. Procedures and test criteria needed for evaluating CNC machinery and tooling	FPHR	474	1.5	2	1	1
3. Techniques needed to make existing information available to decision makers	FPHR	164	1.0			3

Problem 1 **Need to develop techniques to evaluate production /economic implications using new processing**
FY 92 Research Attainments

Publications

Research Unit

Anderson, R. Bruce. 1991. Estimating regional grocery pallet inventory. Pallet Enterprise. 11 (7): 16-20, 65.

Gatchell, Charles J. 1992. More from less,better from worse. In: 46th annual meeting of the Forest Products Research Society; 1992 June 21-24; Charleston, SC. Madison, WI: Forest Products Research Society. Abstract.

(Plenary session presentation. Abstract printed in meeting agenda.)

Gatchell, Charles J. 1992. Gang-rip-first to increase the value of low-grade hardwoods. In: Rose, M. Annette, ed. Alternatives for the 90's: wood products, technologies and international markets: Conference proceedings; 1991 November 1-2; Cambridge, OH. Morgantown, WV: Appalachian Export Center for Hardwoods and Southern Ohio Wood Industry Consortium: 74-77.

Hoff, Kristen G.; Adams, Edward L.; Walker, Elizabeth S. 1992. Computer optimization of hardwood parts yield using gang-rip-first procedures. Forest Products Journal. 42 (3): 57-59.

Hoff, Kristen G.; Sarin, Subhash C.; Anderson, R. Bruce. 1992. Graphic model of the processes involved in the production of casegood furniture. Res. Pap. NE-666. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 40 p.

Cooperative

Osborn, Lawrence E.; Gatchell, Charles J.; Hassler, Curt C. 1992. West Virginia yellow-poplar lumber defect database. Res. Pap. NE-660. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 10 p.

(Work conducted through a formal cooperative agreement with West Virginia University.)

Extramural

Patterson, David W.; Armstrong, James P. 1992. Value of yellow-poplar lumber and moulded products by sawing pattern, log size, and log grade. In: 46th annual meeting of the Forest Products Research Society; 1992 June 21-24; Charleston, SC. Madison, WI: Forest Products Research Society. Abstract.

(This Technical Forum presentation resulted form work through a formal cooperative agreement with West Virginia University.)

Attainment

To remain competitive, today's wood products manufacturers must respond quickly to rapidly changing customer demands with quality products. In the past, the primary means of ensuring timely market response was to carry excess inventory. As customers began to demand greater variety, many manufacturers found themselves carrying large inventories of goods which they could no longer sell. We have developed a framework of decision making which allows wood products manufacturers to consider these tradeoffs based on the concepts of computer integrated production planning. This algorithm, developed specifically for the furniture production process, schedules production such that due dates are met with minimal inventory carrying costs and machine setup costs. The algorithm determines the processing sequence of the orders as well as the optimal lot size of each product scheduled. The problem is constrained by workforce and machine capacities at each work center. Although this algorithm was developed for wood furniture manufacturers, it may be applied to other wood products firms as well. Millwork producers and dimension plants can easily adapt this methodology to their operations. Determining production schedules through computerized algorithms tend to reduce inventory levels and improve response time to market shifts, without the expense of a complete manufacturing resource planning package.

Problem 2 **Procedures and test criteria needed for evaluating CNC machinery and tooling**
FY 92 Research Attainments

Publications

Research Unit

Adams, Edward L. 1992. USDA offers help for evaluating CNC woodworking equipment. Wood & Wood Products. 97 (1): 76-77.

Anderson, R. Bruce. 1992. How to justify CNC equipment. Furniture Design & Manufacturing. 64 (4): 38, 40, 42, 44.

Cooperative

Conners, Richard W.; Cho, Tia-Hoon; Ng, Chong T.; Drayer, Thomas T.; Araman, Philip A.; Brisbon [Brisbin], Robert L. 1990. A multisensor machine vision system for hardwood defect detection. In: Faust, Timothy D., ed. Proceedings, process control/production management of wood products: technology for the 90's; 1990 October 31-November 1; Athens, GA. Athens, GA: University of Georgia: 99-111.

(Work conducted through a formal cooperative agreement with Virginia Tech. RWU-SE-4702 also involved with research.)

Extramural

Stewart, J.S.; Morris, R.; Tang, Y.; Adams, R.A. 1992. An evaluation of the balance accuracy of typical CNC router bits and cutters. Unpublished report on file at the Forestry Sciences Laboratory, Princeton, WV.

(Major report of results from formal cooperative agreement with North Carolina State University. Ed Adams, RWU scientist, provided significant contributions in study planning and review of results.)

Attainment

The buyers and sellers of computer numerically controlled (CNC) woodworking equipment need to talk the same language when attempting to match machines to specific jobs in the wood processing plant. The fact that there are no standard procedures available for evaluating these machines has resulted in some plant managers purchasing machines that will not meet their needs or the machines are much more sophisticated than required. This is costly in dollars to the buyers and in negative advertisement to the sellers. We are developing equipment evaluation procedures to help solve this problem. Since the router is the most versatile piece of CNC equipment, evaluation procedures are being developed for it first. Procedures have been or are being developed for evaluating: (1) spindle characteristics such as available cutting power (kilowatts) and tool balance requirements; (2) table travel characteristics such as parallelism, pitch, and yaw; (3) spindle vs table relationships to measure the ability of the router to respond to the computer commands; (4) machining accuracy and repeatability of routers under different cutting loads; (5) health and safety features such as dust and noise; and (6) cost justification tools for making purchase decisions. Once draft procedures are finished, a committee of engineers from the equipment manufacturers, sellers, and users will critique them and provide direction in their final development.

Problem 3 **Techniques needed to make existing information available to decision makers**
FY 92 Research Attainments

Publications

Cooperative

Hansen, Bruce G.; Luppold, William G.; Thomas, R. Edward. 1991. Revised data on U.S. hardwood lumber export volumes to Europe, 1981 to 1990. Northern Journal of Applied Forestry. 8 (4): 156-160.

Luppold, William G.; Thomas, R. Edward. 1991. New estimates of hardwood-log exports to Europe and Asia. Res. Pap. NE-659. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 24 p.

Luppold, William G.; Thomas, R. Edward. 1991. Revised estimates of hardwood log exports to major EC and Pacific Rim markets. Forest Products Journal. 41 (7/8): 35-40.

Attainment

RWU personnel continue to develop and maintain on-line relational databases of information that can be accessed interactively to quickly answer questions from industrial managers and technical personnel. Information added to the database this year includes properties of domestic and foreign hardwoods. Available information includes woodworking machinery manufacturers, dealers, and machinery descriptions with an emphasis on computer-controlled machinery; basic statistics and analyses of hardwood product import and export trade data; and sources of woodworker training for the newer technologies. The information has been disseminated by several methods in the past year. Exhibits of RWU research were presented at two major international industry trade fairs and four regional trade shows during the year. Four presentations were made at industry and professional meetings. And over 700 individual inquiries were answered during the year. About 60 percent of the inquiries came from the wood-using industry. The remainder were from other researchers, state organizations, rural development commissions, and consultants. About one-half of the inquiries relate to economics and hardwood product trade statistics; 20 percent concern wood processing machinery; and the remainder concern wood technology, woodworker training, and sources of supply for wood products.

Northeastern Forest Experiment Station
Forest Products and Harvesting Research
Research Work Unit 4702

Forest Engineering Research–Timber Harvesting Systems and Equipment for Steep Terrains

Peters, Penn A., Project Leader

FY 92 Research Attainments
Research Work Unit Summary

Problem number and title	Functional account	Current funding	Current staffing	Research Outputs: Research unit	Research Outputs: Extra-mural	Research Outputs: Cooperative
		thousand dollars	*scientist years*			
1. Lack of suitable timber harvesting systems and equipment in steep terrain	FPHR	150	1.0	7		
2. Inadequate timber harvesting production and cost estimating tools	FPHR	0	.0			

Problem 1 **Lack of suitable timber harvesting systems and equipment in steep terrain**
FY 92 Research Attainments

Publications

Research Unit

Peters, P.A. 1991. Chainsaw felling fatal accidents. Transactions of the ASAE. 34 (6): 2600-2608.

Peters, P.A. 1991. Correlating production of accumulating feller-bunchers. Transaction of the ASAE. 34 (4): 1024-1030.

Peters, Penn. 1991. Chainsaw felling fatal accidents. Presented at: Forest Products Research Conference: 1991 September 24-26: Madison, WI. Unpublished. 1 p. Abstract.

(Abstract for poster presentation.)

Peters, Penn. 1991. Innovative harvesting technologies. Presented at: Forest Products Research Conference: 1991 September 24-26: Madison, WI. Unpublished. 1 p. Abstract.

(Abstract for Poster Presentation.)

Peters, Penn. 1992. Letter to the Editor. Northern Logger. 5(12):16.

(Letter was written to correct an error citing author's research.)

Peters, Penn A. 1992. Broken top kills feller. Safety Alert 92-S-19. Washington, DC: American Pulpwood Association. 1 p.

Peters, Penn A. 1992. Mechanized felling on 40 to 100 percent slopes. Pap. No. 917545. St. Joseph, MI: American Society of Agricultural Engineers. 9.

Attainment

There are over fifty cable yarders operating in the Eastern United States today compared to two operating in the early seventies. Cable yarding now accounts for approximately 10 percent of the volume harvested in the mountainous regions of the Eastern United States. The Research Work Unit has supported the adoption of this technology through systematic study of the productivity and costs of a range of sizes of cable yarders to determine the most efficient application of cable yarders as a function of timber stand characteristics. The ultimate steep slope feller-buncher may be a walking robot that theoretically could negotiate 100 percent slopes. Barriers to commercial development of a steep slope, walking, feller-buncher have been reported. Logging has the highest annual fatality rate of any occupation with 200 fatalities per 100,000 workers; compared to a rate of 8 per 100,000 workers for all industries. This unacceptable situation may become worse as hardwood and partial cut harvesting, important factors in reported accidents, are expected to increase. The most common fatal accident occurs when the victim is struck by a tree or part of a tree. Research has identified struck by hazards in the felling area for which suggested safe practices do not give adequate protection.

Problem 2 **Inadequate timber harvesting production and cost estimating tools**
FY 92 Research Attainments

Publications

none

Attainment

Since problem initiation in 1985, time studies have been reported on the Bitterroot and Clearwater cable yarders, the FMC FT-180CA high speed tracked vehicle, a Hydro-Ax 511 feller-buncher, a Radio Horse 9 prebunching winch, and a Rottne-Snoken 810 harvester-processor. The relationship between feller-buncher productivity, tree diameter, and trees per acre has been explained by correlating the results of several feller-buncher field studies. The productivity of rubber-tired skidders has also been correlated from the research literature. Cable yarding stump-to-mill costs have been published for several east coast yarders. Computer programs to estimate cable yarding costs as a function of yarder characteristics and stand characteristics have been published. Funds and staffing for this problem were terminated in fiscal year 1987.

Northeastern Forest Experiment Station
Forest Products and Harvesting Research
Research Work Unit 4751

Systems to Integrate Harvesting With Other Resource Management Objectives
LeDoux, Chris, Project Leader

FY 92 Research Attainments
Research Work Unit Summary

Problem number and title	Functional account	Current funding	Current staffing	Research Outputs		
				Research unit	Extra-mural	Cooper-ative
		thousand dollars	*scientist years*			
1. Inadequate forest management planning tools for steep terrain	FPHR	167	1.0	3		2
2. Inadequate methods to plan/carry out multiproduct harvest./util. of E. hardwood on steep terrain	FPHR	167	1.0	1		

Problem 1 **Inadequate forest management planning tools for steep terrain**
FY 92 Research Attainments

Publications

Research Unit

Layton, Deborah A.; LeDoux, Chris B.; Hassler, Curt C. 1992. Cost estimators for construction of forest roads in central Appalachians. Res. Pap. NE-665. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 4 p.

LeDoux, Chris B.; Baumgras, John E.; Sherar, James; Campbell, Tom. 1991. Production rates and costs of group selection harvests with a Christy cable yarder. In: Stokes, Bryce J.; Rawlins, Cynthia L., eds. Forestry and Environment...Engineering Solutions; 1991 June 5-6; New Orleans, LA. ASAE Publ. 09-91. St. Joseph, MI: American Society of Agricultural Engineers: 75-84.

LeDoux, Chris B.; Huyler, Neil K. 1992. Cycle-time equations for five small tractors operating in low-volume small-diameter hardwood stands. Res. Pap. NE-664. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 6 p.

Cooperative

Erickson, Michael D.; Hassler, Curt C.; LeDoux, Chris B. 1991. Silvicultural treatments and logging costs for minimizing gypsy moth impacts. In: 1991 international winter meeting of the American Society of Agricultural Engineers; 1991 December 17-20; Chicago, IL. Pap. 91-7524. St. Joseph, MI: American Society of Agricultural Engineers: 1-15.

May, Dennis M.; LeDoux, Chris B. 1992. Assessing timber availability in upland hardwood forests. Southern Journal of Applied Forestry. 16 (2): 82-88.

Attainment

Group selection harvest units that span most mixed hardwood sites were studied. The yarding conditions and variables used to develop the production data cover the range of conditions normally encountered in cable logging of hardwoods. The prediction equations can be used to develop reliable estimates of stump-to-landing production rates that along with other associated costs, can be used to estimate group selection harvesting costs. Prediction equations for estimating cycle time were developed for five small tractors studied under various silviculture treatments and operating conditions. Results suggest that using small tractors to harvest low value small-diameter wood is economical if markets for products exist. Use of small tractors also helps minimize damage to the harvest site. Total job costs estimators were developed for two methods of forest road construction. Results show that roads constructed using total-job methods cost up to five times as much as roads built when equipment is rented hourly. The estimators developed are for well-drained, stone-surfaced, permanent, minimum-to-high standard roads. Results of this research have been presented to resource managers, policy makers and other researchers through publications, symposia, and other appropriate outlets.

Problem 2 **Inadequate methods to plan/carry out multiproduct harvest./util. of E. hardwood on steep terrain**
FY 92 Research Attainments

Publications

Research Unit

Baumgras, John E.; LeDoux, Chris B. 1992. Computer software to estimate timber harvesting system production, cost, and revenue. In: Proceedings of FORS Ninth Annual Computer Conference. Gen. Tech. Rept. NC-. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station:

Attainment

Forest growth and timber harvesting system simulations were applied to determine the effects of silvicultural prescriptions and roundwood markets on the economic feasibility of thinning upland oak stands. Results published and presented at a symposium demonstrate the significant impacts of stand age at thinning and thinning intensity on harvesting costs, multiproduct yields, and net cash flow. The results indicate that variable roundwood markets can postpone commercial thinning 10 to 20 years, or eliminate thinning as a management option. The analysis of roundwood harvesting and marketing options also shows the importance of multiproduct harvesting to generating the cash flows required for commercial thinning. A publication and presentation describing computer software for estimating harvesting cash flows provides the forest industry and forest land managers with information and technology required to identify economically feasible timber harvesting opportunities, select appropriate harvesting technology, and determine the potential cost of modifying harvesting practices to reduce environmental impacts.

Northeastern Forest Experiment Station
Resource Analysis Research
Research Work Unit 4801

Forest Inventory and Analysis
Peters, John R., Project Leader

FY 92 Research Attainments
Research Work Unit Summary

Problem number and title	Functional account	Current funding	Current staffing	Research Outputs		
				Research unit	Extra-mural	Cooper-ative
		thousand dollars	*scientist years*			
1. Conduct periodic forest resources inventories and evaluations	RAR	2320	.5	5		1
2. Conducting special analyses of specific resource issues and concerns	RAR	628	2.0	8		2

Problem 1 **Conduct periodic forest resources inventories and evaluations**
FY 92 Research Attainments

Publications

Research Unit

Krusic, Paul J., Jr.; Hornbeck, James W. 1989. Preserving decayed wood samples for tree-ring measurement. Tree-Ring Bulletin. 49: 23-27.

Wharton, Eric H.; Kayse, Stephen C.; Nevel, Robert L., Jr. 1992. The timber industries of Kentucky, 1986. Resour. Bull. NE-120. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 37 p.

Widmann, Richard H. 1992. Pulpwood production in the Northeast–1990. Resour. Bull. NE-123. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 27 p.

Widmann, Richard H.; Hackett, Ronald L. 1992. Downturn seen in 1990 pulpwood production. The Northern Logger and Timber Processor. 40 (10): 20-21.

Widmann, Richard H.; Long, Michael. 1992. Ohio timber products output-1989. Resour. Bull. NE-121. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 21 p.

Cooperative

Beltz, Roy C.; Cost, Noel D.; Kingsley, Neal P.; Peters, John R. 1992. Timber volume distribution maps for the Eastern United States. Gen. Tech. Rep. WO-60. Washington, DC: U.S. Department of Agriculture, Forest Service. 59 p.

Attainment

Forest managers and policy makers need up-to-date information for effective decisions about development and use of the resource. Timber volume distribution maps were developed for the Eastern United States. They will help wood users determine where volumes of important species are concentrated. Data collected in cooperation with state forestry organizations in Kentucky and Ohio reveal large increases in the use of central hardwoods. Most of the production was in sawlogs for lumber and most of the sawlog volume was oak and yellow poplar. Pulpwood production in the 20 northern States fell slightly in 1990. This downturn followed four consecutive years of increases. These trends in timber harvesting provide vital inputs for decisions about resource development and use, and for policies aimed at balancing the Nation's timber budget. Results of this research have been presented to resource managers, policy makers, and other researchers through resource bulletins, symposia, and other appropriate outlets.

Problem 2 **Conducting special analyses of specific resource issues and concerns**
FY 92 Research Attainments

Publications

Research Unit

Birch, Thomas W. 1992. Land ownership and harvesting trends in Eastern forests. In: Proceedings of the 20th annual hardwood symposium of the Hardwood Research Council: the future of multiple use forestry in Eastern hardwood forests; 1992 June 1-3; Cashiers, NC. Memphis, TN: Hardwood Research Council: 143-157.

Brooks, Robert T.; Millers, Imants; Dickson, David R. 1991. Forest health monitoring in the United States: the 1990 Experience in New England. In: IUFRO workshop on monitoring air pollution impact on permanent sample plots, data processing and results interpretation; 1991 September 2-6; Prachatice, Czechoslovakia. Prague, Czechoslovakia: Department of Ecological Monitoring of Forestry and Game Managment Research Institute: 12-21.

Gansner, David A.; Birch, Thomas W.; Sheffield, Raymond M.; McWilliams, William H. 1991. Central Appalachian hardwoods: getting bigger and stocking up. National Woodlands. 14 (4): 12-15.

Gansner, David A.; Birch, Thomas W.; Sheffield, Raymond M.; McWilliams, William H. 1992. Central Appalachian hardwoods: getting bigger and stocking up. The Allegheny News. April: 17-19.

Gansner, David A.; Widmann, Richard H.; Arner, Stanford L.; Alerich, Carol L.; Quimby, John W. 1992. Pennsylvania oak suffers from gypsy moth assults. The Northern Logger and Timber Processor. 41 (1): 20-21.

McWilliams, W.H.; Wharton, E.H. 1992. Landscape-level arboreal data for forested wetlands: the U.S. Forest Service regional inventories. Global Wetlands Old World and New: Intecol's 4th international wetlands conference; 1992 September, 13-18; Columbus OH. Columbus OH: School of Natural Resources, The Ohio State University: 90. Abstract.

McWilliams, William H.; Mills, John R. 1992. Status of forest resources in the United States. In: The american bar association section of natural resources, energy, and environmental law: private sector timberland issues; 1992 May 8; New Orleans, LA. [Place of publ. unknown]: [Publisher name unknown]: Tab A-28p.

Widmann, Richard H.; Gansner, David A.; Arner, Stanford L.; Alerich, Carol L.; Quimby, John W. 1992. Impact of gypsy moth on oak timber supplies in Pennsylvania District 7. In: Proceedings of the national gypsy moth review; 1991 November 4-7; Raleigh, NC. [Place of publ. unknown]: [Publisher name unknown]: 93-97.

(Held at Mission Valley Inn, Raleigh, North Carolina)

Cooperative

Lindsay, John J.; Gilbert, Alphonse H.; Birch, Thomas W. 1992. Factors affecting the availability of wood energy from non-industrial private forest lands in the Northeast. Resour. Bull. NE-122. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 19 p.

Zipperer, Wayne C.; Birch, Thomas W. 1992. Forest land ownership. In: New York-New Jersey Highlands regional study. Washington, DC: U.S. Department of Agriculture; 34-37.

Northeastern Forest Experiment Station
Resource Analysis Research
Research Work Unit 4803

An Anal. of Domestic & International Demands for Hardwood Lumber & Veneer & Domestic Supplies of These Products

Luppold, William G., Project Leader

FY 92 Research Attainments
Research Work Unit Summary

Problem number and title	Functional account	Current funding	Current staffing	Research Outputs: Research unit	Research Outputs: Extra-mural	Research Outputs: Cooperative
		thousand dollars	*scientist years*			
1. Explain the interrelationships among domestic markets for hardwood products	RAR	437	2.0	6	1	4
2. Develop more detailed information on int'l. hardwood products trade and describe impact	RAR	522	2.5	13		4
3. Market-based decision making tools which can be used by hardwood processors and rural	RAR	120	.5		5	3

Problem 1 **Explain the interrelationships among domestic markets for hardwood products**
FY 92 Research Attainments

Publications

Research Unit

Dempsey, Gilbert P.; Luppold, William G. 1992. The state of hardwood lumber markets. The Northern Logger & Timber Processor. 40 (9): 22-23, 30.

Nolley, Jean W. 1991. Bulletin of hardwood market statistics: spring 1991. Res. Note NE-346. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 45.

Nolley, Jean W. 1991. Bulletin of hardwood market statistics: summer 1991. Res. Note NE-347. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 45.

Nolley, Jean W. 1992. Bulletin of hardwood market statistics: fall 1991. Res. Note NE-348. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 47 p.

Nolley, Jean W. 1992. Bulletin of hardwood market statistics: winter 1991. Res. Note NE-349. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 43 p.

West, Cynthia D.; Bahn, Kenneth D.; Sinclair, Steven A. 1991. Competitive policy paradigm of technology adoption: an empirical investigation. In: Chapman, Richard L.; Sharp, William R., eds. Preparing the way: technology transfer in the 21st Century; 1991 June 9-11; Denver, CO. Indianapolis, IN: Technology Transfer Society: 318-332.

Cooperative

Doud, Lynn F.; Johnson, Walter W.; Blackenhorn, Paul R.; Stover, Lee R.; Luppold, William G. 1992. A description of the 1987 kitchen cabinet industry in Pennsylvania. Forest Products Journal. 42 (4): 33-39.

(Work performed under cooperative agreement with The Pennsylvania State University.)

Forbes, Craig; Punches, John; Sinclair, Steve; Luppold, Bill. 1991. Wood and wood based material use in the wood furniture industry. Res. Update. Blacksburg, VA: Virginia Polytechnic Institute and State University, Department of Wood Science and Forest Products. 4.

(Work performed under cooperative agreement with Virginia Polytechnic Institute and State University.)

Meyer, Christopher J.; Michael, Judd H.; Sinclair, Steven A.; Luppold, William G. 1992. Wood material use in the U.S. wood furniture industry. Forest Products Journal. 42 (5): 28-30.

(Work performed under cooperative agreement with Virginia Polytechnic Institute and State University.)

Michael, Judd; Meyer, Christopher; Sinclair, Steven A.; Luppold, William G. 1991. Wood and wood-based material use in the wood furniture industry. In: FPRS 45th annual meeting: biographies & abstracts; 1991 June 23-26; New Orleans, LA. Madison, WI: Forest Products Research Society: 41. Abstract.

Extramural

[anon.]. 1992. Characteristics influential in the furniture industry's hardwood lumber purchase decisions. Res. Update. Blacksburg, VA: Virginia Polytechnic Institute and State University, Department of Wood Science and Forest Products. 4 p.

(Work performed under cooperative agreement with Virginia Polytechnic Institute and State University.)

Attainment

Hardwood lumber is the most important solid hardwood product emanating from our domestic hardwood resource. In 1991, NE-4803 scientists estimated hardwood lumber usage by major industries exceeded 10.7 billion board feet. This volume represents nearly 30 percent increase over the estimated 1982 use level. Although the 1991 recession caused a broad decline in hardwood lumber use by most major users, use by the railroad tie industry and hardwood lumber exports have remained strong. Pallets continue to be the largest single user of hardwood lumber consuming 45 percent of total industrial use. The major user of higher grade hardwood lumber is the furniture industry. Research results indicate that nearly 75 percent of the hardwood lumber consumed by this industry is used in the southern region. Over one-fourth of the lumber used by the furniture industry is red oak while the combination of red oak, yellow-poplar, and white oak account for 54 percent. Although the furniture industry is the largest user of higher grade hardwood lumber, the growth of this industry has been stymied by a large increase in furniture imports. In 1991, over 23 percent of the furniture consumed in the United States emanated from international sources. Another important domestic user of hardwood lumber is the kitchen cabinet industry, which consumed over 600 million board feet in 1991. This industry has been one of the fastest growing hardwood industries as indicated by the 60 percent growth in employment between 1982 and 1991.

Problem 2 **Develop more detailed information on int'l. hardwood products trade and describe impact**
FY 92 Research Attainments

Publications

Research Unit

Hansen, Bruce G. 1991. An overview of Asian and European markets for U.S. hardwood lumber. In: FPRS 45th annual meeting: biographies & abstracts; 1991 June 23-26; New Orleans, LA. Madison, WI: Forest Products Research Society: 21. Abstract.

Hansen, Bruce G. 1991. Taiwanese wood product manufacturers' use of United States hardwood lumber. In: FPRS 45th annual meeting: biographies & abstracts; 1991 June 23-26; New Orleans, LA. Madison, WI: Forest Products Research Society: 44. Abstract.

Hansen, Bruce G.; Luppold, William G. 1991. New estimates of hardwood lumber exports to Europe and Asia: market trends, species, and sources. In: FPRS 45th annual meeting: biographies & abstracts; 1991 June 23-26; New Orleans, LA. Madison, WI: Forest Products Research Society: 44. Abstract.

Hansen, Bruce G.; Luppold, William G. 1992. An overview of Japanese market for U.S. hardwoods. Import/Export Wood Purchasing News. 18 (5): 3, 18.

Hansen, Bruce G.; Luppold, William G.; Thomas, R. Edward. 1991. Revised data on U.S. hardwood lumber export volumes to Europe, 1981 to 1990. Northern Journal of Applied Forestry. 8 (4): 156-160.

Luppold, William G. 1991. Can good policy be developed from bad data?. In: Chang, Sun Joseph, comp. Proceedings, Southern Forest Economics Workshop on environmental concerns, government regulations, new technology and their impact on southern forestry; 1991 February 20-22; Washington, DC. Baton Rouge, LA: Louisiana State University Agricultural Center: 129-136.

Luppold, William G. 1992. Discrepancies in international trade data and approaches to eliminate the impact of data problems. In: Adams, Darius; Haynes, Richard; Lippke, Bruce; Perez-Garcia, John, comps. Proceedings of international symposium: Forest sector, trade and environmental impact models: theory and applications; 1992 April 30-May 1; Seattle, WA. Seattle, WA: University of Washington, Center for International Trade in Forest Products: 164-172.

Luppold, William G.; Thomas, R. Edward. 1991. New estimates of hardwood-log exports to Europe and Asia. Res. Pap. NE-659. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 24 p.

Luppold, William G.; Thomas, R. Edward. 1991. Revised estimates of hardwood log exports to major EC and Pacific Rim markets. Forest Products Journal. 41 (7/8): 35-40.

Martens, Dave. 1992. International markets for millwork. In: Rose, Mary Annette, ed. Alternatives for the 90's: wood products, technologies and international markets; 1991 November 1-2; Cambridge, OH. Morgantown, WV: Appalachian Export Center for Hardwoods; Southern Ohio Wood Industry Consortium: 44-51.

West, Cynthia; Smith, Paul. 1992. International markets for wood furniture. In: Rose, Mary Annette, ed. Alternatives for the 90's: wood products, technologies and international markets; 1991 November 1-2; Cambridge, OH. Morgantown, WV: Appalachian Export Center for Hardwoods; Southern Ohio Wood Industry Consortium: 1-12.

West, Cynthia D. 1991. An analysis of international trade in hardwood chips. In: FPRS 45th annual meeting: biographies & abstracts; 1991 June 23-26; New Orleans, LA. Madison, WI: Forest Products Research Society: 43. Abstract.

West, Cynthia D.; Sinclair, Steven A. 1991. Technological assessment of the wood household furniture industry. In: FPRS 45th annual meeting: biographies & abstracts; 1991 June 23-26: New Orleans, LA. Madison, WI: Forest Products Research Society: 43. Abstract.

Cooperative

Armstrong, James P.; Ponzurick, Thomas G.; Luppold, William G. 1991. United States hardwood exports to Canada. In: FPRS 45th annual meeting: biographies & abstracts; 1991 June 23-26; New Orleans, LA. Madison, WI: Forest Products Research Society: 45. Abstract.

Hammett, A.L., III; Cubbage, Frederick W.; Luppold, William G. 1991. Southern Appalachian hardwood lumber manufacturers: characteristics of exporters and nonexporters. Forest Products Journal. 41 (7/8): 70-76.

(Work performed under cooperative agreement with the University of Georgia.)

Hammett, A.L., III; Cubbage, Frederick W.; Luppold, William G. 1992. A logistical regression model of southern hardwood lumber export participation. Wood and Fiber Science. 24 (3): 315-329.

(Work performed under cooperative agreement with the University of Georgia.)

Ponzurick, Thomas G.; Armstrong, James P.; Luppold, William G. 1992. Quality and grading most important to Canadian importers of U.S. hardwoods. Import/Export Wood Purchasing News. 18 (4): 11.

(Work performed under cooperative agreement with West Virginia University.)

Attainment

Exports have been the fastest growing segment of the hardwood lumber market. Research by NE-4803 indicates that a substantial portion of the growth in hardwood lumber exports to Japan since 1986 was a result of the 50-percent decrease in the value of the dollar against the yen. Efforts to accurately track this growth have been hindered by data problems. Project scientists have continued to aid the U.S. Department of Commerce (USDC) in isolating the problems causing errors in hardwood export statistics. Because the USDC was unable to correct historic errors in hardwood product exports, project scientists developed alternative hardwood product export statistics. In FY '92, new estimates of hardwood log exports were released as was a review of the methods used to develop these statistics. As efforts continued on correcting errors in U.S. hardwood product export statistics, errors were also found to exist for other forest products and in statistics released by non-U.S. sources. Therefore, considerable efforts were made in FY '92 to inform other scientists on the source of errors in international trade and methods to correct these errors. Although the international trade of furniture has been growing on a global basis, the United States has not been able to take advantage of this growth. Factors hindering U.S. furniture producers have been transportation costs, relative wage rates, and the inability to design furniture for international consumers.

Problem 3 **Market-based decision making tools which can be used by hardwood processors and rural**
FY 92 Research Attainments

Publications

Cooperative

Meimban, R.J.; Mendoza, G.A.; Luppold, W.G.; Araman, P. 1992. A simulation model for a hardwood sawmill decision support system. Journal of Forest Engineering. 4 (1): 39-47.

(Work performed under cooperative agreement with the University of Illinois.)

Mendoza, G.A.; Sprouse, W.L.; Araman, P.A.; Luppold, W.G. 1991. CEASAW: a user-friendly computer environment analysis for the sawmill owner. In: Proceedings, 1991 symposium on systems analysis in forest resources; 1991 March 6-7; Charleston, SC. Gen. Tech. Rep. SE-74. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station: 173-179.

(Work performed under cooperative agreement with the University of Illinois.)

Mendoza, Guillermo A.; Sprouse, William; Luppold, William G.; Araman, Philip; Meimban, Roger J. 1991. An integrated management support and production control system for hardwood forest products. Computers in Industry. 16 (4): 343-351.

(Work performed under cooperative agreement with the University of Illinois.)

Extramural

Bodenman, John E.; Smith, Stephen M.; Jones, Stephen B. 1991. The location decision of hardwood manufacturing in the northern and central Appalachian states. Staff Pap. 196. University Park, PA: The Pennsylvania State University, College of Agriculture. 16 p.

(Work performed under cooperative agreement with The Pennsylvania State University.)

Jones, Stephen B.; Bodenman, John E.; Smith, Stephen M. 1992. Characteristics of hardwood manufacturers in the northern and central Appalachian states. Forest Products Journal. 42 (6): 33-41.

(Work performed under cooperative agreement with the Pennsylvania State University.)

Meimban, R.J.; Mendoza, G.A. 1991. A simulation-based decision support system for designing, planning and controlling sawmill operations. Agricultural Systems and Information Technology Newsletter. 3 (3): 62-63.

(Work performed under cooperative agreement with University of Illinois.)

Meimban, Roger J.; Mendoza, Guillermo A.; Carino, Honorio. 1992. Integrating economic performance and process simulation models in evaluating sawmill design alternatives. Wood and Fiber Science. 24 (1): 68-72.

(Work performed under cooperative agreement with University of Illinois.)

Mendoza, G.A.; Sprouse, W.L.; Meimban, R.J. 1991. CEASAW: a computer-assisted decision support system for sawmill owners. Agricultural Systems and Information Technology Newsletter. 3 (3): 64-65.

(Work performed under cooperative agreement with University of Illinois.)

Attainment

As hardwood manufacturing firms become more vertically integrated, scheduling between the various facilities of the firm become more complex. For instance, a firm must coordinate activities such as processing logs into lumber and lumber into secondary products. Research completed by NE-4803 cooperators has approached this problem by developing a decision making model that links manufacturing activities at each level of the production process. Much of the lumber produced from timber in Appalachia is shipped to secondary hardwood processors in neighboring regions. This lumber is manufactured into furniture that is shipped throughout North America. Rural development authorities in the Appalachian region are constantly asking what type of firms may locate in their regions and will these firms produce products to sell outside the region. Research completed by NE-4803 cooperators examines the characteristics of secondary manufacturers already located in the Appalachian region. This research found a difference between locally-owned and non-locally owned facilities. Although both locally and non-locally owned facilities obtained the majority of the wood material within the state they were located, the non-locally owned facilities had a higher tendency to sell their manufactured products out-of-state.

Northeastern Forest Experiment Station
Resource Analysis Research
Research Work Unit 4804

Economic Potential of Forest Production in the North
Sendak, Paul E., Project Leader

FY 92 Research Attainments
Research Work Unit Summary

Problem number and title	Functional account	Current funding	Current staffing	Research Outputs		
				Research unit	Extra-mural	Cooper-ative
		thousand dollars	*scientist years*			
1. Lack of understanding of reasons for underutilization of timber resource in the North	RAR	346	2.8	12	1	3
2. The implementation of ATLAS for the North will require extensive research on forest inventory	RAR	30	.2			

Problem 1 **Lack of understanding of reasons for underutilization of timber resource in the North**
FY 92 Research Attainments

Publications

Research Unit

Dennis, D.F.; Sendak, P.E. 1991. Factors influencing involvement of a forester in managing non-industrial forests. Journal of Environmental Management. 33: 169-173.

Dennis, Donald F. 1991. A censored regression approach to modeling harvest behavior. In: Buford, Marilyn A., comp. Proceedings of the 1991 symposium on systems analysis in forest resources; 1991 March 3-6; Charleston, SC. Gen. Tech. Rep. SE-74. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station: 348-354.

Dennis, Donald F. 1992. Parcelization and affluence: implications for nonindustrial private forests. Northern Journal of Applied Forestry. 9 (1): 33-35.

Dennis, Donald F. 1992. The effect of trends in forest and ownership characteristics on recreational use of private forests. In: Vender Stoep, Gail A., ed. Proceedings of the 1991 Northeastern Recreation Research Symposium; 1991 April 7-9; Saratoga Springs, NY. Gen. Tech. Rep. NE-160. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 116-117.

Dennis, Donald F.; Sendak, Paul E. 1991. Which landowners use professional foresters?. The Consultant. 36 (4): 10, 12.

Dennis, Donald F.; Sendak, Paul E. 1992. An empirical study of enrollment in Vermont's Use Value Appraisal property tax program. Canadian Journal of Forest Research. (Sept.); 22: 1209-1214.

Huyler, Neil K. 1991. Small tractor harvesting technology. In: Environmental impacts of wood-based products and processes: a mandate for change; 1991 September 24-26; Madison, WI. [Place of publication unknown]: [Publisher name unknown]: 4. Abstract.

(This publication was included in the "Speaker Abstracts Received" (Session I, Harvesting Technologies).)

Sendak, Paul E. 1991. Re-expressing interest rates estimated from the exponential model. Journal of Applied Forestry. 8 (4): 172-173.

Sendak, Paul E. 1992. State and federal timber stumpage prices in Vermont. Northern Journal of Applied Forestry. 9 (3): 97-101.

Sendak, Paul E. 1992. Timber sale value as a function of sale characteristics and number of bidders. Res. Pap. NE-657. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 7 p.

Sendak, Paul E. 1992. What's a fair price for forest land?. Vermont Forest Quarterly. 11 (2): 10-11.

Sendak, Paul E.; Tritton, Louise M.; Martin, C. Wayne. 1992. Interdisciplinary forest management. In: Maple syrup production: Proceedings of the North American Maple Syrup Council Technical Session; 1991 October 21-23; Batavia, NY. NRAES-62. Ithaca, NY: Northeast Regional Agricultural Engineering Service: 20-29.

Cooperative

LeDoux, Chris B.; Huyler, Neil K. 1992. Cycle-time equations for five small tractors operating in low-volume small-diameter hardwood stands. Res. Pap. NE-664. Radnor, PA: U.S. Department of Agriculture, Forest Service. 6 p.

Lutz, Jack; Howard, Theodore E.; Sendak, Paul E. 1992. Stumpage price reporting in the northern United States. Northern Journal of Applied Forestry. 9 (2): 69-73.

(Work unit provided partial funding through a research cooperative agreement. Work unit scientist wrote study plan and reviewed drafts of the final report.)

Turner, Robert; Newton, Carlton M.; Dennis, Donald F. 1991. Economic relationships between parcel characteristics and price in the market for Vermont forestland. Forest Science. 37 (4): 1150-1162.

(Work unit provided partial funding through a research cooperative agreement. Work unit scientist assisted with data analysis and interpretation and reviewed drafts of the final report.)

Extramural

Chase, Warren E. 1991. Maine stumpage prices: characteristics and trends 1963-1990. Durham, NH: University of New Hampshire. 121 p. M.S. thesis.

(Work unit provided partial funding through a research cooperative agreement.)

Attainment

Almost 1/2 the Nation's hardwoods, approx. 140 billion cubic feet of growing stock and 334 billion board feet of sawtimber, are contained in the Northeast and North Central regions. Most of this timber grows on privately owned lands where growth exceeds removals by almost 2 to 1. Timber stumpage prices determine the profitability of a forestry operation. An analyses of Maine's stumpage price trends completes a series of studies for the three northern New England states of Maine, New Hampshire, and Vermont. Of 22 states in the northeastern quadrant of the U.S., 20 collect and publicly report timber stumpage prices. An evaluation of these state reports showed that no two states used the same procedures. A more standard approach among the states in the region would make the reported stumpage prices more useful, especially for multi-state analyses. An examination of stumpage prices received on Green Mountain National Forest timber sales and Vermont State Lands sales indicated that differences in prices can be largely explained by differences in timber quality, lower quality being found, on average, on the National Forest. Parcel size and landowner affluence were found to be important determinants of behavior for nonindustrial provide forest landowners. Current trends in these variables do not bode well for timber harvest and public recreation access on these lands. However, analyses of modified property tax programs indicate that the motivation of a tax incentive may be sufficient to mitigate this tendency. In Vermont, there was also a strong positive correlation between landowners' level of formal education and the propensity to seek forestry assistance. The accomplishments help to explain reasons for under utilization of the timber resource and help in the formation of strategies for increased utilization. Results have been communicated through publications and meetings.

Problem 2 **The implementation of ATLAS for the North will require extensive research on forest inventory**
FY 92 Research Attainments

Publications

none

Attainment

Work on this problem was initiated during 2/92 with funding being provided by RPA and the Northern Global Change Research Program. Working with a contractor, the ATLAS computer program was installed in Burlington and procedures designed for testing it on northern forest types. The RPA timber inventory data base was found to be inadequate for estimating yield functions for the North. Therefore, procedures were developed to utilize tree-level data from Forest Inventory and Analysis. The initial work will focus on the northern hardwood timber-type group, utilizing data from Maine, New Hampshire, New York, and Vermont. Results will be communicated through publications and meetings. A validated ATLAS for the North should be of value to the RPA Assessment, Northern Global Change Research Program, and our own Research Work Unit.

Northeastern Forest Experiment Station
Resource Analysis Research
Research Work Unit 4951

Forest Recreation Investment Research
Echelberger, Herbert E., Project Leader

FY 92 Research Attainments
Research Work Unit Summary

Problem number and title	Functional account	Current funding	Current staffing	Research Outputs		
				Research unit	Extra-mural	Cooper-ative
		thousand dollars	*scientist years*			
1. Inadequate knowledge of costs of investments in provision of forest recreation opportunities	RAR	33	.0	3		
2. Inadequate knowledge of factors affecting perceived quality of recreation opportunities	RAR	171	1.5	3	1	
3. Recreation oppor. investments made w/inadequate understanding of costs/perceived quality.	RAR	165	1.5	5		3

Problem 1 **Inadequate knowledge of costs of investments in provision of forest recreation opportunities**
FY 92 Research Attainments

Publications

Research Unit

Echelberger, Herbert E.; Glass, Ronald J.; More, Thomas A. 1992. A case study of Lake Champlain fishing access sites in Vermont. In: The 4th North American symposium on society and resource management: book of abstracts; 1992 May 17-20; Madison, WI. Madison, WI: University of Wisconson-Madison, College of Agricultural and Life Sciences: 3. Abstract.

Echelberger, Herbert E.; Thomas, Kristine E. 1991. Cross-country skiing's contribution to enhanced rural living. In: Zeigler, Joanne F., ed. Enhancing rural economics through amenity resources, a national policy symposium; 1990 May 1-5; State College, PA. University Park, PA: The Pennsylvania State University: 99-104.

Glass, Ronald J.; Walton, Gerald S.; Echelberger, Herbert E. 1992. Estimates of recreation use in the White River drainage, Vermont. Res. Pap. NE-658. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 10 p.

Attainment

The following reflects major accomplishments for the life of this problem. Problem 1 of the RWUD states that "Investments in the provision of forest recreation opportunities are often made with inadequate knowledge of all the costs involved." Since the initiation of this RWUD in 1983, many studies have addressed this problem at the federal and state levels and in the private sector. "Anatomy of Backcountry Management Costs," NEFES Res. Pap. No. 575 examined what costs were providing backcountry experiences at federal facilities. "Trends in the cost of providing public outdoor recreational opportunities" examined costs at more developed sites at both federal and state facilities. It was published in the proceedings of the 1985 National Outdoor Recreation Trends Symposium. At the 1984 NRPA Symposium on Leisure Research "Costs and revenues in Delaware state parks with implications for management strategies" examined the situation at the state level. Several studies addressing costs and revenues at private campgrounds and cross country ski areas have served these industries well. In particular, "Nascent trends in the private campground industry" appears in the 1985 National Outdoor Recreation Trends Symposium and "Tracking the economic health of the cross country ski industry: 1984-1988" appears in the Proceedings of the Outdoor Recreation Trends Symposium III in 1990.

Problem 2 **Inadequate knowledge of factors affecting perceived quality of recreation opportunities**
FY 92 Research Attainments

Publications

Research Unit

Glass, Ronald J.; More, Thomas A.; DiStefano, James J. 1992. Vermont trappers: characteristics, motivations, and attitudes. Transactions of the Northeast Section of the Wildlife Society. 48: 134-143.

More, Thomas; Tritton, Louise; Glass, Ronald. 1992. Moral dimensions of wildlife management. In: The 4th North American symposium on society and resource management: book of abstracts: 1992 May 17-20; Madison, WI. Madison, WI: University of Wisconsin-Madison, College of Agricultural and Life Sciences: 171-172. Abstract.

More, Thomas A.; Averill, James. 1992. Satisfaction, happiness, and emotion in the recreation experience: are we asking the right questions? In: The 4th North American symposium on society and resource management: book of abstracts; 1992 May 17-20; Madison, WI. Madison, WI: University of Wisconsin-Madison, College of Agricultural and Life Sciences: 256. Abstract.

Extramural

Heywood, John L. 1991. Visitor inputs to recreation opportunity spectrum allocation and monitoring. Journal of Park and Recreation Administration. 9 (4): 18-30.

(Unit assisted in the design of the project and the construction of the survey instrument.)

Attainment

Providing quality recreation experiences for visitors is a basic goal of all recreation management. Unit research on this important topic has progressed well and has provided significant breakthroughs on both applied and conceptual levels. On the applied level, the unit's research has focused on identifying activity and site attributes that contribute to quality. In developed forest recreation sites, research has helped to identify the setting attributes that contribute to quality for different user groups. Users of private campgrounds, for example, desire low-noise, private sites and clean well-maintained restrooms. They also appreciate facilities like game rooms that aid operator profits. Tenters in modern public facilities show similar preference patterns except that they dislike profit-oriented facilities; while users of primitive public facilities are very nondemanding, except for their extreme dislike of profit-oriented facilities. Similar kinds of applied studies have helped to clarify relationships between quality and site attributes for wildlife-oriented recreation activities and for users of urban parks and forests. On the conceptual level, the problem requires understanding of just what a quality recreation experience is. Significant work on the emotional dimensions of the recreation experience has led to the development of a new theory of recreation quality. The theory helps to explain the reasons why some of the attributes identified in the applied studies are important and suggest new interpretations that have been overlooked. This appears to be an enormously fruitful area for future research leading to new management insights and prescriptions. "Visitor inputs to ROS allocation and monitoring" describes a technique for obtaining information on users' subjective perceptions of preferred relationships between a setting's biophysical, social, and managerial conditions.

Problem 3 **Recreation oppor. investments made w/inadequate understanding of costs/perceived quality.**
FY 92 Research Attainments

Publications

Research Unit

Echelberger, Herbert E. 1992. Forest recreation research: real answers to real questions. Vermont Forest Quarterly. 10 (4): 21-22.

Echelberger, Herbert E.; More, Thomas A. 1992. Resident perceptions of Vermont state parks. In: Vander Stoep, Gail A., ed. Proceedings of the 1991 Northeastern recreation research symposium; 1991 April 7-9; Saratoga Springs, NY. Gen. Tech. Rep. NE-160. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 94-97.

Glass, Ronald J.; Muth, Robert M. 1992. Subsistence as a component of the mixed economic base of developing countries: systematic evaluation of economic impacts on subsistence fisheries users. In: World Fisheries Congress Abstract Bulletin; 1992 May 3-8; Athens, Greece. [Place of publication unknown]: [Publisher name unknown]: 58. Abstract.

(Publisher's name and location not apparent.)

Glass, Ronald J.; More, Thomas A. 1992. Equity preferences in the allocation of goose hunting opportunities. Journal of Environmental Management. 35 (4): 271-279.

Glass, Ronald J.; More, Thomas A.; Siemer, William F.; Brown, Tommy L.; Batcheller, Gordon R.; DiStefano, James J. 1992. Trappers in New York and Vermont: comparisons of social characteristics and motivations. In: Vander Stoep, Gail A., ed. Proceedings of the 1991 Northeastern recreation research symposium; 1991 April 7-9; Saratoga Springs, NY. Gen. Tech. Rep. NE-160. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 134-138.

Cooperative

Muth, Robert M.; Kruse, John A.; Glass, Ronald J. 1992. Subsistence use of renewable natural resources by rural residents of southeast Alaska. In: The 4th North American symposium on society and resource management book of abstracts; 1992 May 17-20; Madison, WI. Madison, WI: University of Wisconsin-Madison, College of Agricultural and Life Sciences: 25. Abstract.

Stevens, T.H.; Glass, R.; More, T.; Echeverria, J. 1991. Wildlife recovery: is benefit-cost analysis appropriate?. Journal of Environmental Management. 33: 327-334.

Stevens, Thomas H.; Echeverria, Jaime; Glass, Ronald J.; Hager, Tim; More, Thomas A. 1991. Measuring the existence value of wildlife: what do CVM estimates really show?. Land Economics. 67 (4): 390-400.

Attainment

Several publications have addressed the issue of understanding relationships between the costs of providing outdoor recreation experiences and their perceived quality. "Resident perceptions of Vermont state parks" successfully used the semantic differential technique in evaluating recent state park visits. A widely accepted tool used to understand peoples' perceptions of values associated with outdoor recreation is the Contingent Valuation Method (CVM). This technique was seriously questioned as a means of measuring benefits in relation to costs for wildlife existence values. "Wildlife recovery: is benefit-cost analysis appropriate?" suggests that CVM may ask people to choose between ordinary goods (income) and a moral principle and that such choices are likely to produce conflict and ambivalence. "Measuring the existence values of wildlife: What do CVM estimates really show?" argues that CVM shouldn't be used in wildlife experiments because many respondents cannot or will not assign a monetary value to wildlife.

Northeastern Forest Experiment Station
Resource Analysis Research
Research Work Unit 4952

Structure and Function of Urban Forests
Rowntree, Rowan A., Project Leader

FY 92 Research Attainments
Research Work Unit Summary

Problem number and title	Functional account	Current funding	Current staffing	Research Outputs		
				Research unit	Extra-mural	Cooper-ative
		thousand dollars	*scientist years*			
1. Structure and function of urban forest systems	RAR	1628	5.5	20	4	3

Problem 1 **Structure and function of urban forest systems**
FY 92 Research Attainments

Publications

Research Unit

McPherson, E. Gregory. 1991. Cooling urban heat islands with sustainable landscapes. Work. Pap. 91-10. Tuscon, AZ: The Drachman Institute for Land and Regional Development Studies, The University of Arizona. 16 p.

McPherson, E. Gregory. 1991. The bottom line on trees. Journal of Arboriculture. 17(12):334. Abstract.

(Presentation abstract. No proceedings.)

McPherson, E. Gregory; Rowntree, Rowan A. 1991. The environmental benefits of urban forests. In: The International Society of Arboriculture. A national research agenda for urban forestry in the 1990's. Urbana, IL: The International Society of Arboriculture: 45-49.

McPherson, E. Gregory. 1991. Economic modeling for large-scale urban tree plantings. In: Vine, E.; Crawley, D.; Centolella, P., comps., eds. Energy efficiency and the environment: forging the link. Washington, DC: American Council for an Energy-Efficient Economy: 349-369.

McPherson, E. Gregory. 1992. Environmental benefits and costs of the urban forest. In: Rodbell, Phillip D., ed. Proceedings of the 5th National Urban Forest Conference.; 1991 November 15-19; Los Angeles, CA. Washington, DC: American Forestry Association: 52-54.

McPherson, E. Gregory; Biedenbender, Sharon. 1991. The cost of shade: cost-effectiveness of trees versus bus shelters. Journal of Arboriculture. 17 (9): 233-241.

McPherson, E. Gregory; Minor, Charlotte T.; Guertin, D. Phillip. 1991. A prototype model of residential irrigation water use. In: 10th conference on biometeorology and aerobiology: special session on hydrometeorology; 1991 September 10-13; Salt Lake City, UT. Boston, MA: American Meteorological Society: 63-68.

McPherson, E. Gregory; Ratliffe, Judith D.; Sampson, Neil. 1992. Lessons learned from successful tree programs. In: Akbari, H.; Davis, S.; Dorsano, S.; Huang, J.; Winnett, S., comps., eds. Cooling our communities: a guidebook on tree planting and light-colored surfacing. Washington, DC: Environmental Protection Agency: 63-92.

McPherson, Greg. 1991. Cost effective ecological landscapes. Earthword. 2: 40-41.

Muick, Pamela C. 1991. Effects of shade on blue oak and coast live oak regeneration in California annual grasslands. In: Proceedings of the symposium on oak woodlands and hardwood rangeland management; 1990 October 31-November 2; Davis, CA. Gen. Tech. Rep. PSW-126. Berkeley, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station: 21-24.

Nowak, David J. 1991. Analysis of an urban forest. Journal of Arboriculture. 17(12):334. Abstract.

(Presentation abstract. No proceedings.)

Nowak, David J. 1992. "Smog check your trees": clouding the issue. Arborist News. 1 (1): 13, 15.

Nowak, David J. 1992. Urban forest structure and the functions of hydrocarbon emissions and carbon storage. In: Rodbell, Phillip D., ed. Proceedings of the 5th National Urban Forest Conference.; 1991 November 15-19; Los Angeles, CA. Washington, DC: American Forestry Association: 48-51.

Nowak, David J.; McBride, Joe R. 1992. Differences in Monterey pine pest populations in urban and natural forests. Forest Ecology and Management. 50: 133-144.

Pouyat, R.V.; McDonnell, M.J. 1991. Heavy metal accumulations in forest soils along an urban-rural gradient in southeastern New York, USA. Water, Air, and Soil Pollution. 57: 797-807.

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Attainment

Progress in FY92 is: (1) A procedure, with supporting empirical data, for estimating the carbon storage and carbon dioxide sequestration potential of urban forests in the U.S. was published in J. of Arboriculture which reaches most people involved with urban forests and will allow then to compare the carbon potential of the current urban forest with potential improvements after management. It also provides guidelines for comparing urban forest carbon sequestering with carbon emission rates of urban land uses (Rowntree and Nowak). (2) Three articles advanced understanding of the role of urban forests in the direct (e.g. shading) and indirect (e.g. air cooling) effects on energy consumption for air conditioning (McPherson). (3) Four articles analyzed methods of quantifying and qualifying benefits and costs of urban forests under different management conditions (McPherson). (4) A prototype model of residential irrigation water use was developed and offers urban forest stewards a means for solving one of the major problems of sustaining urban trees in western, semi-arid regions (McPherson). (5) A paper to the Fifth National Urban Forest Conference weighs the costs of biogenic (tree producing) hydrocarbons (a precursor to ozone) against the carbon storage benefits of these trees (Nowak). (6) At the same conference, a paper discusses the "limits of acceptable change" concept as a method of managing urban forest change in expanding urban areas (Zipperer). (7) Refinement of a model of changes in soil structure and development along an urbanization gradient continued (Pouyat).

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